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The Sound and the Fury 82

As a follow-up to their *Independence Day* phenomenon, director Roland Emmerich and producer Dean Devlin opted to reinvent a classic Japanese film franchise with *Godzilla*. Under visual effects supervisor Volker Engel, the newly-formed Centropolis Effects created a twenty-story-tall digital Godzilla, supported by practical creature effects from Patrick Topoulos Designs, plus extensive physical effects, both large and small, by Clay Pinney and Joseph Viskocil. *Article by Kevin H. Martin.*

Hide It in Shadow, Hide It in Light 112

After a five-season run, the television sensation *The X-Files* leaped to the big screen in a feature film produced by *X-Files* creator Chris Carter and directed by series regular Rob Bowman. In addition to makeup and creature effects by Amalgamated Dynamics Incorporated, the motion picture featured an abundance of postproduction work—supplied principally by Light Matters and Blue Sky/VFX—overseen by visual effects supervisor Mat Beck. *Article by Jody Duncan.*

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COVER—A gigantic lizard prowls the streets of New York in *Godzilla*.

DEEP IMPACT THE ANGRY ROCK

ARTICLE BY KEVIN H. MARTIN

The second half of the twentieth century has given many a soul cause to gaze bleakly into the future – especially since the advent of the nuclear era rendered self-destruction on a global level a grim, but distinct possibility. To a large extent, however, filmmakers chose to ignore such concerns and focus instead on outside causes for the cataclysmic end of life on this planet. In the early fifties, the George Pal production of *When Worlds Collide* stirred and shook audiences with its depiction of biblical-scale flooding and the utter destruction of planet earth. Then, in the late seventies, there was *Meteor* – a by-the-book disaster movie – which concerned itself with Cold War politics and cheapjack spectacle, eschewing the human element inherent in such a dramatic situation.

Armed with heavier, character-driven product from screenwriters Bruce Joel Rubin and Michael Tolkin, *Deep Impact* differed markedly from both its predecessors and its similarly themed summer competitor, the Michael Bay thriller *Armageddon*. With political aspects largely, and wisely, played out off-screen, the film focused on several families and their reactions to the coming doomsday while astronauts struggle to complete a mission to destroy a comet on a collision course with earth. The DreamWorks offering, like last year's *The Peacemaker*, was directed by TV veteran Mimi Leder. With heavy-duty assistance from production designer Leslie Dilley and special effects coordinator Michael Lantieri, Leder would depict a world caught in the throes of panic during the countdown days to near-total devastation.

But for the actual destruction, and to realize scenes in space featuring the comet and spacecraft, DreamWorks turned to Industrial Light & Magic. Most of ILM's key effects personnel on the show – including visual effects supervisor Scott Farrar and co-supervisor Bill George – were veterans of numerous space films, with experience in both motion control and computer generated effects. “We went down for a production meeting,” George remarked, “and one thing made clear at that meeting was that this was not going to be an effects film. Producers always say that, but this time they really meant it – the focus of the film was human emotion and drama.” Even so, the script featured an abundance of ambitious visual effects sequences and an initial effects shot count that was far afield of budgetary constraints. “What had been allocated for effects and what was described in the script were two different things. The production had been boarding what they wanted to see, which was okay early on – ignore the money and get the concept out there – but then it became our job to make those concepts fit the budget.”

Numerous meetings with the producers and director finally focused the effects effort. “We kept doing ballparks for them,” recalled visual effects producer Denise Ream, “figuring out how many shots they could get for the money. Originally they had 120 complicated boards, not including wire removals. We ended up combining those into fewer, more elaborate shots, each of which had to tell a lot of story.” The production's own storyboard artists implemented suggestions by Scott Farrar and Bill George, and revised boards were subsequently translated into animatics by ILM's Louis Katz, who utilized Form-Z to create the models and Electric Image for animation.

The effects workload fell into three categories. The first involved the comet itself, which would be seen in space as well as in a series of shots as it approaches earth and finally makes impact in the Atlantic Ocean. The second category would require miniatures for scenes of a spacecraft, the Messiah, entering the comet's tail and landing on its surface in a sequence combining live-action, filmed on an enormous stage set at Paramount, with a variety of miniature and digital embellishments. Finally, the film would depict a massive tidal wave – the result of the comet's impact – inflicting wholesale destruction as it engulfed the eastern seaboard of the United States.



*Attempting to flee, but mired in a traffic jam, people gaze skyward as a massive comet streaks overhead in the Mimi Leder film, *Deep Impact*, with visual effects by Industrial Light & Magic.*



Modelmakers at work on a manned spacecraft launched in an effort to destroy the comet before it can destroy the earth.



Effects art director Alex Jaeger confers with modelmakers Brian Gernand and Carol Bauman during construction.

A seminal design issue was the comet – its surface, body and tail. “The rule established early on was ‘no potato,’” Scott Farrar declared, “since everyone doing comets comes up with something that looks like a rolling potato. While we did not slavishly follow scientific extrapolations for the look of the comet, we did want to err on that side, because every college kid has seen Hale-Bopp on TV and knows what a real comet looks like. You could point to parts of our comet and argue that they were scientifically accurate – but, in truth, it has more animation, more color and more body. A real comet is fairly circular, and the tail doesn’t follow behind it – it aims away from the sun at all times. We put in a sideways tail for one scene, just to see if it would work, but we soon realized the audience wouldn’t buy it.”

Scientific authenticity gave way to dramatic visual impact as the filmmakers pushed for an ever more threatening-looking comet. “Imbuing a ball of gas with threatening, evil attributes is very challenging,” George admitted. “We went too soft and pretty at first, with beautiful blue and fuchsia colors in the comet. Then, in response to the ‘too pretty’ comments we got from production, we mixed in colors like yellow and brown. The comet was always described as a dirty snowball; but the problem with snow is that it can look like a winter wonderland. So we kept it darker and moodier.”

The design of the comet evolved in tandem with the development of an appropriate methodology for achieving the shots, one that would not depend entirely on the all-too-common particle systems approach. “Most off-the-shelf particle animation programs have a tutorial instructing you to do a comet – which is just a ball with particles streaming off,” noted CG sequence supervisor Joel Aron, who took on the responsibility of developing the look and methodology of the comet. “We wanted to get more of an organic cloud look, something that was beautiful yet terrifying – like a jellyfish.” After seven months of going back-and-forth with the filmmakers, the ILM team developed a comet that fulfilled everyone’s expectations. “I called it the ‘angry rock.’ It was a fierce looking rock with beautiful colors surrounding it, as if it had cobalt blue and fuchsia scarves wrapped around it.”

To achieve the look, Aron hand-painted organic imagery, then layered that artwork around a piece of 3-D rock geometry. “There were layers and layers of this hand-painted art,” recalled Aron, “each of which was altered subtly to create some variation. Painting those textures and layering them on the comet gave it more life than we could have achieved with particle systems.” Animation of the imagery was achieved by applying the artwork to a rendered patch of fractals, then putting the patch in motion. “That kept the comet from seeming like a piece of wallpaper stuck onto geometry



Bauman adds detailing for scenes after the ship has been battered passing through the comet's coma.

flying through space, and it gave it the necessary volume. The first test I did floored people because it had a gaseous, fluid look, yet it wasn't Dynamation."

Dynamation particles were used, however, for the comet's tail – or coma – the look of which was devised by CG sequence supervisor Henry Preston. "We tried a bunch of things to make the coma look cosmic and organic and surreal," Preston recalled, "and we ended up using fast-moving clumps of particles, with some geometry added for fill and to create harder edges. But most of the foreground interior comet details came from millions of particles. The tricky part was to create a transition from the patch-based comet to the particles in the coma. Ultimately, the two looked close enough to allow us to cut from one to the other."

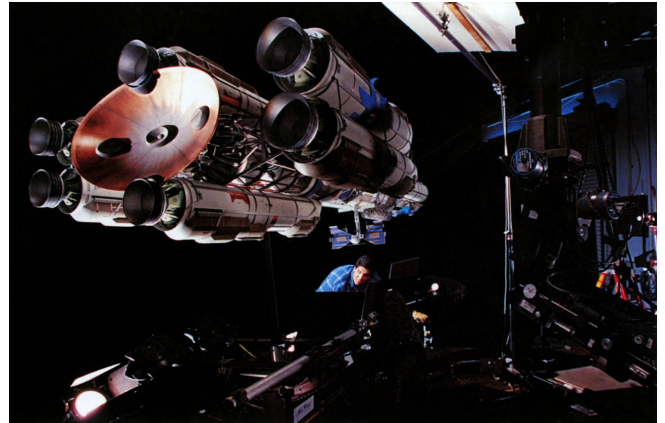
The appropriately named Messiah, the spacecraft that would transport a team of astronauts to the surface of the comet in the hope of saving the planet, was designed entirely on computer by Les Dilley and his art department team, then built as a practical model by the ILM model shop. "The art direction suggested that they had used spaceship components from past and present space programs to build this thing," noted model supervisor Brian Gernand. "There were large boosters on the side that looked like United States shuttle boosters; but there were also Russian tanks. Other areas of the ship were reminiscent of Apollo program rockets. There were also different color combinations used on the ship to indicate that some of the parts were from the Russian program, while others were from the United States."

The optimum size for the ship model was determined by first building it as a foamcore mockup. "We built the first mockup ten feet long," recalled Gernand, "which was dictated by Bill George. He wanted a ship that big so he would have plenty of detail to work with." The mockup was then translated into a practical model of the exoskeletal ship. "The exoskeleton was fashioned from steel via laser-cutting, while the rockets were cast in fiberglass. The tail cones had to withstand some hot projector lights, so we used aluminum epoxy to cast them up. The rest of the model was constructed from tube and form patterns. There were functioning cargo doors and a fully lit fiber-optic cockpit interior with translight monitors." In addition to the ten-foot, 48th-scale complete ship, the modelmakers constructed a six-foot, 16th-scale lander section of the Messiah, specifically for close views of the landing module approaching the comet's surface. "The landing module had double-action landing gear in both the front and back, plus articulated thrusters that rotated downward to slow the ship and land it." A modular, 48th-scale space station, a 32nd-scale tug craft, a two-foot, 50th-scale shuttle and two comet landscapes completed the miniatures slate.

The Messiah was filmed by director of miniature photography Patrick Sweeney on ILM's stages. Traditional crane arm motion control camera setups were supplemented by model-movers – cradle mechanisms that could pitch and roll the model independently. "There were a lot of shots where the ship goes through turbulence or gets hit by debris as it's going into the comet," noted Sweeney, "and we wanted to be able to manipulate the ship and have it move in the lighting as opposed to rolling or moving the camera. We kept the model stationary in one part of the stage; so while the camera did all the moving through space, the model ship was turning and rolling and yawing on its own axis. Another thing we had to take into account was that the Messiah model was detailed only on one side. To utilize that side, regardless of shot direction, we had to mirror-image and shoot backwards."

The ship was filmed against bluescreen so that appropriate background images could be composited in later. “What would be seen out the windows of the Messiah was a question mark at the time,” noted Bill George. “We weren’t sure what the coma was going to look like or if stars would be visible. So we just shot everything bluescreen. If we had known then what we know now, we’d have probably shot more against black. There were a lot of tiny windows on the ship, and a sliver of black space would have been acceptable.” The stage floor was also covered in blue for specific down-angles, particularly the first reveal of the Messiah, in which the camera moves up and over the ship.

Altogether, Sweeney’s motion control model photography crew produced between ten and fifteen shots of the Messiah. “The difficult thing with the Messiah, in terms of shooting it, was all the different colors on it,” Sweeney noted. “A lot of times with a big model you can throw a giant light on it, representing the sun, and it’ll look good. But in this case, that wasn’t good enough. The model had a lot of different colors, so we had to come in with special lights. My gaffer, Michael Olague, spent a lot of time setting up inkies coming from all different directions. The dark gray spheres in the back of the model just disappeared and went black on film, so we had to highlight each of those. Red is a color that likes to disappear also, so we highlighted the red areas; then the green tanks would disappear, so we’d have to highlight those. There were also kick lights to make the ship look good. It wasn’t as simple as just turning on a few lights and shooting. It was quite an ordeal.” Multiple passes were required, including a beauty pass, a matte pass and a ‘comet interaction’ light pass to tie the spacecraft in with the turbulent activity surrounding it as it enters the coma.

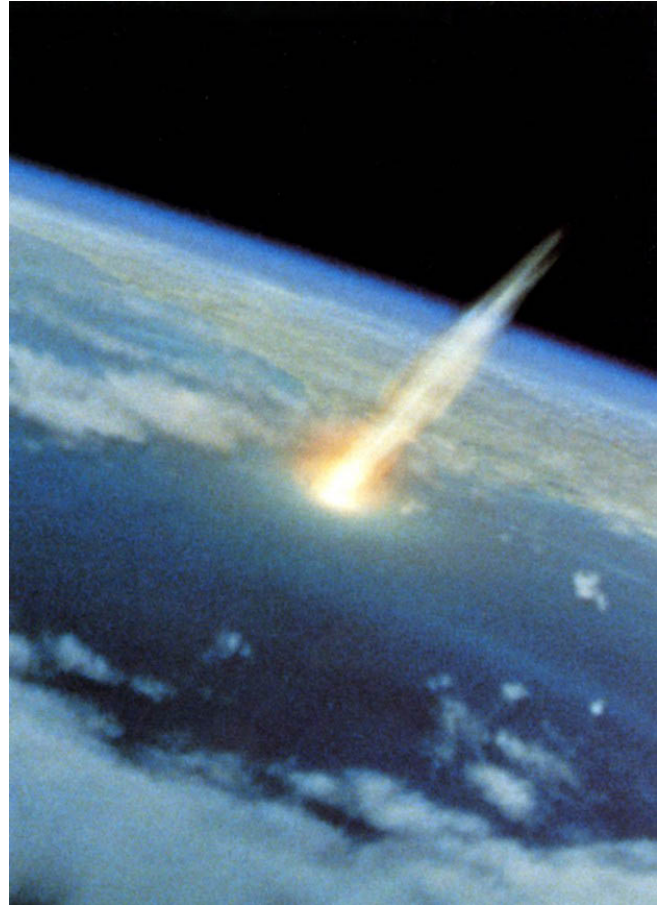


Gaffer Mike Olague studies the spacecraft model during preparation for a motion control pass.

One of the first reveals of the spaceship has it emerging from a space station that has served as its construction site. In designing and building the orbital station, the model crew tried to duplicate the look of the real-life Mir space station as closely as possible, while fashioning a modular piece that would facilitate a variety of camera angles on the motion control stage. "With Brian's tinker-toy space station," Sweeney related, "we could flip sections around to maintain the proper orientation, regardless of the direction or angle of the shot." For the shot of the ship exiting its dock, the space station and Messiah models were shot together to avoid a composite. "It was the easiest way to go. The ship was on one track so it could physically move away from the station. It was just a matter of coordinating the camera and the model-movers."

As the Messiah nears its destination, after five months in space, it breaks through the gas layer on approach to the comet surface. Perspective changes in depicting the approach mandated alterations in the digital comet simulation. "We had set up the particle simulation for one angle," Henry Preston commented, "but when the camera started moving through it, that simulation didn't look as good. We also wanted to have some interaction with the motion control Messiah. So we did a match-move, then roughed out a 3-D ship matte that let us put the ship in and drop it back on top of the gas."

Entering the turbulent coma, the Messiah is pummeled with boulders, one of which shears off the ship's antenna. A modified model was required for shots of the ship after it has been damaged by coma debris. "We built additional components for the nose, the lights and the thrusters," said Brian Gernand, "and the remainder of the damage was suggested via paint work. All of that paint work had to be reversible since we had to be able to go from damaged to clean, then back to damaged fairly easily. We utilized rubber cement tints that were washable, at least in theory. The idea was to spray on the rubber cement; and when it came time to



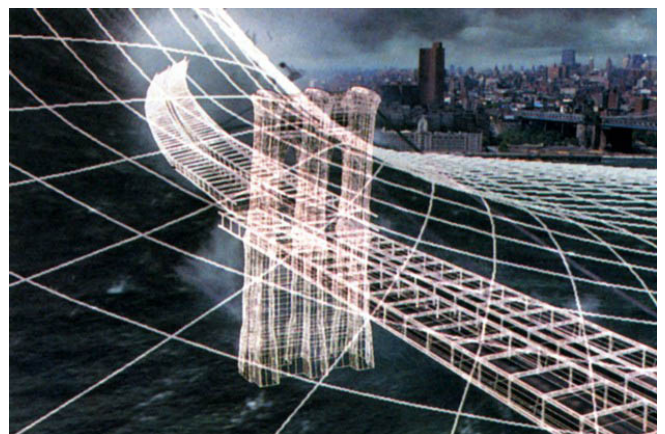
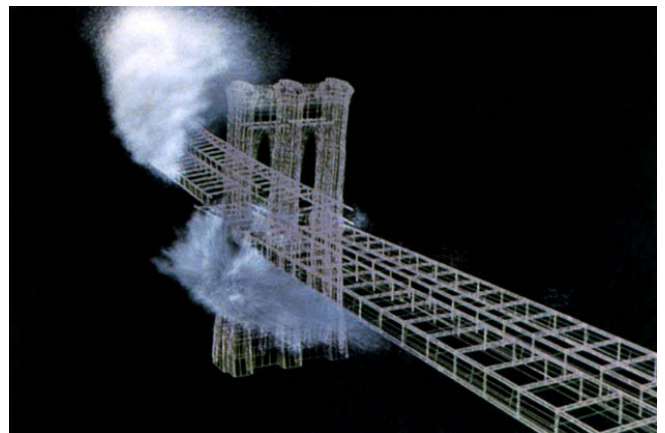
remove it, we could either rub it off or use very mild solvents.”

Soon thereafter, a frigate of the navy, the *gesta* to the board of the United States, producing a devastating Shockwave.

A shot of the ship being struck by a giant rock required Sweeney's crew to choreograph the model to react as if being hit. "It took some programming time on my part to figure out how much the ship would displace itself in space when it gets hit by the rock," commented Sweeney. "We determined the direction the ship would move and what speed looked best." The actual severing of the antenna was computer animated. "We shot the model with the undamaged antenna on it all the way through first, then took off the antenna, stuck on the broken one and ran another shot. That way, when the shot was married together, our compositors could make the antenna fly off whenever they wanted."

Despite the damage suffered by the ship, the Messiah manages to land on the comet's surface. Initially, the intent had been to shoot the landing module model on a like-scaled comet landscape miniature. But the in-camera solution was rejected, and the landing shots became composites. "When we looked at it," stated Sweeney, "we realized that the shots would look better if we made the set twice as large in scale to the model. So as it turned out, everything was a composite." The comet surface models were carved from foam and detailed with slate in two scales to represent both the rocky surrounding terrain and the less-jagged landing plain. Cable lines securing the Messiah were CG, though dust and debris were a combination of digital and practical elements.

A team of astronauts set out from the lander to plant nuclear bombs beneath the surface of the comet. Live-action for the sequence was shot on an enormous set built by Les Dille's construction crew. The stage set was brought to life with working geysers and a fiber optic starfield backing. "Their idea was to do it all in-camera," Bill George related. "It turned out great, but we still had to augment the live-action, adding coma to lengthen this already-huge set."



ILM added storm clouds to Manhattan plate photography, then replaced real buildings and other structures with digital replicas as the CG wave overtook and destroyed them.

To accomplish this, Joel Aron used techniques developed for the comet's exterior. "We had to add something like a cyc," remarked Aron, "so I threw artwork onto this flat patch – a piece of geometry for the background that any TD could render. Every shot you see on the surface had a background cyc with nearly the exact same texture as the comet, but altered into sweeping animated tendrils."

To simulate microgravity on the comet as the astronauts set about their task, Robert Harman – known for difficult aerial rigging in pictures such as *The Boy Who Could Fly* – was brought aboard as wire effects coordinator. "He had a whole city of guys over at one side of the stage with big reels of cable," Farrar recalled. "It took two men to operate the up-downs and traverses needed to maneuver each astronaut. The wire removal was terribly difficult – there were wires for suspension and others to insure stability, so each man in a spacesuit needed three cables; and each of those cables cast shadows that had to be removed." Digital rotoscope artist Pat Jarvis performed the painstaking plate restoration on a number of the grueling shots.

Having landed on an area of the comet turned away from the sun, the astronauts are protected for a time from the catastrophically turbulent activity occurring on the sunward side. Unfortunately, the men are still out on the surface when the terminator crosses their position. During this explosive sunrise, one hapless astronaut is caught in a geyser blast and propelled into space, actually achieving escape velocity. While this effect was attempted on stage with the actors on wires – with liquid nitrogen venting and an air-mover filled with cork debris – it met with limited success. "We were with editor David Rosenbloom when I came across a shot of the astronauts lumbering toward camera," George noted. "I thought we could tilt up off this plate and add a CG guy being blown into the air. I was confident we could create something much more spectacular than what they had, which was just a guy on wires and then a cut inside his helmet to the astronaut screaming. I did some Photoshop art and took it to the next meeting. Production bought off on it and wanted the finished shot immediately, so they could show it to executive producer Steven Spielberg. TD Jeremy Goldman got this as a rush job. We kept the beginning with the guy on stage, then added a CG geyser, which obscured things enough to let us put the CG astronaut in. As the geyser clears, you see the CG guy flying up, his legs kicking."

With the astronauts on the surface in jeopardy from the geysers exploding around them, the landing module maneuvers closer to facilitate their recovery. Bursts of thruster fire allow the vessel to set down safely. CG sequence supervisor Tom Martinek began his thruster work by building on



Technical director Ken McGraugh reviews a shot in progress with CG supervisor Ben Snow and technical director Amanda Ronai.

particles created for *Men in Black*, but found the approach too cumbersome for such tiny features. “We developed a shader for the lander thrusters that was a lot faster and easier for the TDs to animate,” explained Martinek. “The big thrusters on the Messiah’s main drive section were done with particles, however.”

As the ship races for earth, the bombs detonate – but succeed only in splitting the comet into two unequal parts, each of which remains on an earth-bound trajectory. Messiah intercepts the larger segment, unleashing its remaining nuclear arsenal with a suicide run that annihilates the world-killer. “The spectacular shots of the Messiah plummeting into the comet, and its explosion, were done by Ed Kramer,” noted CG supervisor Ben Snow. “He used Dynamation to break apart the comet in sections, then combined that with several layers of dust and debris. Then, as the comet pieces hit the earth’s atmosphere, they burn up, creating little trails, generated by Amelia Cherometh.”

Although the larger comet is dispatched, the smaller one preceding it continues on course and finally plunges into the Atlantic, with devastating consequences. “We had a series of shots featuring the comet descending and people looking up at it,” recalled visual effects art director Alex Jaeger, “and all of them were moving camera shots. Then we cut to a shot looking down at the water as the comet comes by overhead and races away.” That shot was immediately followed by a reverse angle of the comet approaching camera, which was consciously designed to give the audience a moment to anticipate what was to come.

Initially, the comet had been small in frame for all of the approach shots; but the filmmakers continually asked for a bigger, more threatening fire in the sky. “Frederic Schmidt generated a comet trail for views of the comet flying through the sky as it approaches impact,” explained Snow. “Russell Earl generated a similar trail using Dynamation. Finally, Chris White married that trail with a foamy water treatment to create a shot of the comet streaking over the ocean.” Raul Essig derived the look of the ocean impact from nuclear explosions, then combined that animation with a Dynamation smoke trail and genuine ocean plates.

The sheer magnitude of the comet’s impact is seen from space, as the blast radiates out in all directions. Joel Aron supervised the creation of this God’s-eye view, with Schmidt handling the impact and Essig the roiling cloud it produces. As this particular shot had been singled out for inclusion in the film’s teaser trailer, it had to be completed as quickly as possible. With Sabre – ILM’s in-house compositing suite – elements created by Schmidt and Essig were composited to meet the trailer deadline. The same tool was utilized more extensively to create the final version. Sabre was also used to generate smaller elements, such as particles for comet enhancement shots.

The enormous wave created by deep impact smashes the east coast, wiping out everything in its path as it surges inland. Scott Farrar considered a variety of practical approaches to depict the wave, ranging from sand to smoke to real water released from dump tanks. “The problem is that dump tanks can only release a limited amount of volume,” explained Farrar. “It hits and then it’s over and done. You don’t get a constant-speed moving wall of water with a constant height. After reviewing every movie with water effects, I decided there was just no way to miniaturize the tidal wave.” Having exhausted other possibilities, Farrar elected to pursue digital techniques for realizing the wave, which would be prominently featured in thirty shots.

The wave development team consisted of Ben Snow, Mitch Deoudes, Ken McGaugh and Doug Sutton. Initial attempts on the effect – based in part on production’s stated intention to depict the wave principally in long shots – involved using ‘blobbies’ or particles. “At that point we didn’t expect to have water coming right up to camera,” Snow said, “so we tried Dynamation simulations to create particles bouncing off walls and each other. I thought that animating a simple Softimage shape with a complex shaded surface might get us a good water look for the big wave itself.”

Snow, Deoudes and McGaugh subsequently divided the monster swell into three components for an establishing shot of the wave striking Manhattan. Snow continued to develop the wave, while Deoudes worked on a leading edge and McGaugh created the spray coming off the top. “The big wave shape needed only simple animation movement,” Snow related, “while the shader we came up with made wave ripples and little foam breakouts. The wave element moved in one direction, so we would reposition the New York background to bring the wave in at whatever angle was needed. The structure of this water became problematic in spray form, though. Mitch Deoudes did a Dynamation simulation that produced shooters of water constantly throwing particles up – like little comets. These would capture the essence of water spray.”

Deoudes’ wave edge spray used a spline within Dynamation to emit particles of varying sizes. “The primary particles would break into shooter particles before thinning to a traveling mist,” revealed Snow. “It was recursive – particles and sub-particles and sub-sub-particles which eventually die off and get reborn. We just had to keep the particle emergences random to get a real sense of water falling over itself. Then there was another mist level that was essential as a filling layer. Without it, there would have been black areas in between the geometrical structures of the wave.”

One shot was an overhead view of the city as the wave fills streets and wraps around buildings. “That became a nightmare,” Snow said. “Andy White did some interesting work with geometry, but we still couldn’t get a sense of waves bleeding around the edges of buildings. Chris Horvath ended up writing a full fluid dynamic simulation – something like ten thousand lines of code. That produced particles which emulated water spray bouncing off buildings and into each other, creating realistic eddies and flow patterns.” Cars swept up by the rushing water were CG elements matched to genuine autos in the live-action plates, while falling buildings were replaced with CG models, facilitated by obtaining plan views of city buildings that established the exact relationship between the structures.

For the shot of Manhattan collapsing beneath the force of the tidal wave, David Horsley built on the barn destruction work from *Twister* to create crumbling buildings. “Using Make Sticky,” Snow said, “the plate buildings were projection-mapped onto prescored geometries, just like a breakaway miniature on stage. David took that into Dynamation. We’d have our building set up for simulation, then slam the wave into the side of the building to make it collapse. Parts of the building would emit water sprays as well.” Sequence



supervisor Greg Killmaster used similar techniques for the subsequent destruction in Washington Square. The water spray levels for the Washington Square shot proved so render-intensive, Killmaster ultimately broke them up into twenty-six CG elements. With added buildings, trees, cars and debris, the shot eventually totaled forty-three separate elements. Significant paint and roto work for sky replacement were also required.

CG sequence supervisor Henry Preston studies a shot of the spaceship being pummeled by comet fragments with technical directors Bruce Powell and Scott Prior.

As the sequence progresses, the wave engulfs a picturesque seaside landscape. CG supervisor Michael Bauer oversaw the beach wave, with Eric Mattson. In the moments prior to the wave reaching the shore, the tide line suddenly recedes – an exaggerated depiction of documented phenomena – dramatically peeling back from the beach. The shoreline effect was a digital manipulation generated by Chris Townsend. “Chris’ effort is nearly invisible on screen, but his work was brilliant,” Farrar asserted. “It took many layers to create the scum foam and water falling back to make this look realistic. The angle looks right down on the coastline from the air, so the terrain beneath the receding waterline needed to be revealed in a completely credible fashion.” John Walker created wave animation for the approach shot, while David Hisanaga handled the side view of the beach being engulfed. To create a moody sky, the shots also featured paint work by Rita Zimmerman.



CG sequence supervisor Michael Bauer reviews a scene of the tidal wave sweeping inland with technical directors Chris Townsend, John Walker and Russell Earl.

One group of people, fleeing inland from the wave, take to the high ground in an attempt to out-climb the surging water. The appearance of the wave at this point – sweeping through valleys and around mountains – differed considerably from the city and beach waves. “The tidal wave has hit land and broken, becoming a rolling, swelling mass,” Bauer said. “John Walker developed a technique – which was carried through the sequence – to make the wave appear menacing as all this foam comes off it.” The look takes on a white-water aspect at certain points as the wave rushes toward thousands of traffic-stalled cars. “We had one geometry representing the landscape, then pulled another 3-D geometry over that to apply a watery look. Doug Sutton came up with a shader for this flowing water surface, while Russell Earl created the leading edge of water as it travels up over the hill.”

Initially, the last shot of the film was to reveal the surging water slowing at mid-mountain level, trapping the survivors on a mountaintop island. “We developed that concept for a month or two,” recalled Alex Jaeger, “but then production decided it was too much. So they went back to the idea of the water receding.” Jaeger ultimately produced twenty-two versions of concept art for the bird’s-eye view of survivors on the high ground. “Except for the live-action foreground, everything in that shot was computer generated.”

“That shot was difficult for many reasons,” explained Bauer. “The live-action mountains had to be replaced by Bill Mather and Rick Rische matte paintings, plus there was extensive tree rotoscoping.

Terry Molatore's digital paint and roto crew had to do nine hundred frames for a line of trees between the camera and all of the surging water activity.”

The picture concludes with a brief matte shot of the nation's capital undergoing reconstruction – firm evidence that more than just hope has survived. *Deep Impact* has proven equally resilient, pulling in more than \$40 million at the boxoffice during its opening weekend and holding its own some weeks later against the onslaught of *Godzilla*. “We knew going in that it was going to be a very difficult project,” commented Denise Reem, “because water is the Holy Grail of visual effects. So accomplishing that, while remaining within budgetary and time constraints, turned out to be our biggest challenge. Fortunately, we worked with a savvy production team that included executive producer Joan Bradshaw and associate producer D. Scott Easton, who had handled big visual effects shows like *Contact* and *The Lost World*. They were very accommodating to us and what we needed, and that made things much easier.”

Deep Impact photographs copyright ©1998 by Paramount Pictures and DreamWorks SKG. All rights reserved. Production still photography by Myles Aronowitz. ILM still photography by Sean Casey and David Owen. Special thanks to Ellen Pasternack, Nagisa Yamamoto, Soni Ede and Riki Leigh Arnold.

LOST IN SPACE LOST IN LONDON

ARTICLE BY MARK COTTA VAZ

The *Lost in Space* TV saga of a space-exploring family adrift in the universe, which debuted on CBS in 1965, was produced in an era of old-fashioned effects. Spacecraft rocketing off-world employed model wire work; distant planet horizons were conjured up as painted backdrops on soundstage sets; and many a scene was played out on 'limbo sets' that incorporated black curtain backgrounds. Those quaint trappings of the past stand in contrast to the blockbuster dimensions of the New Line Cinema feature, which boasted a \$70 million budget and an arsenal of modern visual effects technologies – all at the disposal of stage crews and effects houses in London.

While British film studios had supported first-unit photography for some of the most successful movies ever made – from *Alien* and *Batman* to the *Star Wars* and *Indiana Jones* series – postproduction effects on those films were usually exported to higher-tech facilities in the United States. *Lost in Space*, however, directed by Stephen Hopkins, would be done entirely in England, from the soundstages and backlot of Shepperton Studios to the digital effects houses of London's fashionable Soho district. "Hollywood always comes here to seek a smaller budget and to try to do more with less," observed visual effects supervisor Angus Bickerton, whose resumé includes overseeing the effects for *The Adventures of Pinocchio*, "but Stephen also loved the *James Bond* movie titles and the design sense of the advertising and commercials world here." The *Lost in Space* effects would have posed a daunting challenge anywhere on the planet. Bickerton's earliest count estimate after reading the script was six hundred effects shots – minimum. Eighteen months later, as the production was wrapping post in preparation for its April release date, Bickerton totaled some 770 final shots.

The stellar cast included William Hurt as mission leader Professor John Robinson, Mimi Rogers as his wife Maureen, and Gary Oldman as scheming saboteur Dr. Zachary Smith. Fantastic visual possibilities included a launch dome towering thousands of feet above the polluted skies of futuristic Houston megalopolis, the Robinson family's Jupiter 2 spaceship, rampaging giant robots and alien creatures, and sequences of our heroes marooned on a mysterious planet riddled with time portals.

For early design influence, Hopkins – a devotee of sixties-era Marvel comics – brought in the kinetic, cinematic Marvel work of artists Jim Steranko and the late Jack Kirby. In fact, when Bickerton and production designer Norman Garwood first came onto the project, images from those Marvel comics were pasted on the walls of the production office for inspiration. "That fed a lot of our thinking at the beginning," remarked Bickerton, "particularly the Kirby stuff, since he always drew huge, fantastic machines, which is something Stephen wanted for the J2 and other ships."

The London effects houses Bickerton assembled, all of which viewed *Lost in Space* as an opportunity to showcase U.K. talent on a global stage, included FrameStore, Film Factory, Magic Camera Company, Computer Film Company, Electric Image, Men in White Coats, Cinesite and the London workshops of Jim Henson's Creature Shop. England's own Quantel, an innovator in video and

feature effects technologies since 1976, saw its interactive, real-time Domino image processing and compositing system become a potent postproduction tool for *Lost in Space*. “At the beginning,” commented Bickerton, “I spent a long time challenging Quantel to prove their system to me – and they did. Consequently, a lot of the composites went through Dominos. In the end we had eleven to twelve Domino workstations on the production.”

Things were not completely digital in the *Lost* world, however. An estimated three hundred shots featured models and miniatures work by Magic Model Company, sister company to Magic Camera. from various Jupiter 2 scale models to miniature environments of the alien planet upon which the lost Robinsons eventually land, the abundant workload forced Magic Model to move from their Shepperton Studio workshop to a larger outside facility. And, at the production’s height, some seventy-six modelmakers were on the show.



For the film adaptation of the classic television series, Lost in Space, director Stephen Hopkins and visual effects supervisor Angus Bickerton engaged an array of British companies to do the effects. Among them was Jim Henson’s Creature Shop, which produced two functional robots.

As with the classic TV show, the Robinsons' mission was to reach a habitable world – dubbed 'Alpha Prime' in the movie – beyond the polluted, overpopulated confines of earth. To sabotage the mission, a rival power engages Dr. Smith, who is trapped aboard at the launch, but gains control of the on-board robot in an effort to slay the Jupiter 2 crew. A big-screen wrinkle was the earth-orbit construction of a gigantic, ring-shaped 'hypergate' transporting device. The Robinson family, charged with building a companion gate at Alpha Prime, would create an interstellar gateway for instantaneous colonization of the new world. In an effort to subvert those plans, the 'Global Sedition' stages an attack on the orbiting construction site.

The four-minute, sixty-shot sequence, created by Magic Camera Company, begins with an image of earth produced as a 3-D globe, texture-mapped with a high-resolution satellite image of the planet and embellished with digitally painted clouds. The camera then pans to the partially completed hypergate ring and the orbiting construction city site, built in Lightwave. The image required about 3.2 million polygons and a surface geometry texture-mapped with photographic images of metal plates with rivets, dirt streaks and the like.

Some forty shots in the sequence feature pilot Don West (Matt LeBlanc) and the enemy fighters battling in bubble fighters' — gyroscopic crafts enclosed in plexiglass shields. "The bubble fighters were unique," stated Alan Marques, Magic Camera digital effects supervisor, "with the pilot sitting on a seat attached to a rolling gimbal rig – literally a floating chair on an arc of metal. The plexiglass bubble, which is supposed to be twelve feet across, was all created digitally." The performers were shot motion control sitting in a gimbal rig in front of a greenscreen. The biggest challenge was matching those greenscreen pilot elements to the digital flying bubbles. "We had to write a special plug-in to take the motion control data and feed it into the virtual camera inside 3D Studio Max, one of the CG packages we used on the picture, so that when we ran the computer camera move on the sphere it matched the move on the motion control rig."

The teeming Houston megalopolis seen below was created through some twelve to thirteen models crafted by Magic Model with digital city extensions and atmospheric layers created by Electric Image. "Our Houston panorama was modeled by Marine Poirson in Explore," said Electric Image producer Fiona Watson, "and was rendered in multiple layers to integrate cloud elements and smog effects. This was match-moved to the motion control model elements. Ground level shots were a combination of match-moved CG and multi-pass miniatures." Much of the look of the city was modeled after the work of Syd Mead, a concept illustrator and design contributor to *Blade Runner*.



An opening space battle had actors filmed on a gimbal composited into bubble fighters' by Magic Camera Company.



Futuristic Houston consisted of miniatures, built by Magic Model Company, plus digital enhancements by Electric Image.

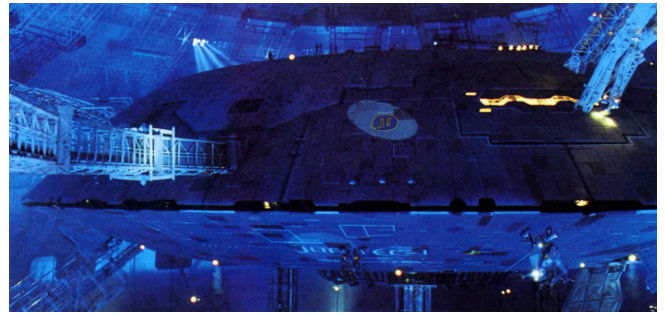
“One shot in particular – a nocturnal fly-through – was unashamedly an homage to *Blade Runner*. Multiple layers of CG rain and fog, flying cars, road traffic, CG and miniature buildings, and other elements were combined to create a dense, oppressive city of the future.”

Models and CG also figured in the launch dome blastoff sequence. The complexity of the launch dome, designed with sixteen segmented sections opening like flower petals, had Bickerton dividing the launch shots between practical and digital effects. An eighteen-foot diameter interior dome model, equipped with actuators, was used to show the opening of one roof section, while a subsequent helicopter view of the full opening was obtained through Electric Image computer graphics.

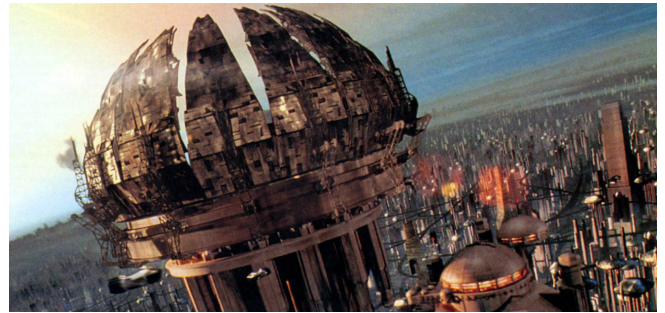
The dome opening revealed a classic saucer ship – the Jupiter 1 launch vehicle, enclosing the oval-shaped Jupiter 2. The Jupiter 2 was designed and developed during an early previsualization phase by digital art director Peter Rubin, who built and rendered a working digital model from ideas and sketches contributed by Hopkins, Garwood and Bickerton. Model unit art director David Warren further finessed the design. Magic Model then constructed several versions of the J2, from a six-foot hero model to a twelve-footer for the alien planet crash-landing sequence. “Some of the models were so big we wouldn’t have been able to pick them up if they were made with traditional materials,” said Magic Model supervisor Jose Granell, “so we used lightweight carbon fiber and kevlar.”

One of the signature elements of the Jupiter 2 was its jump to hyperspace, an effect produced at Cinesite using ‘vari-morph’ software within Cineon. The look of frozen time, which emulated the freeze effect in *Batman & Robin*, was also accomplished without the complexities of the photogrammetry process used in the *Batman* movie. “I thought it would be interesting to have time freezing a bit as they went into hyperspace,” Bickerton noted. “We shot the actors using only ten Nikon F-5 cameras, then used this vari-morph software to synthetically create the frames in-between. Instead of an artist having to selectively delineate areas he wanted to morph, this software would do it for him.”

Morphing would also be used later in the movie for a pullback on the Jupiter 2 lodged in a crater on the alien world. Dubbed the ‘Walton’ sequence – in reference to the ‘goodnight’ voice-overs the Robinson clan exchange – the camera pulls back from an image of Don West looking out the view windows as blast doors close, shrouding the J2 in an alien night. Cinesite created the 500-frame pullback with only six Nikon stills of the model sitting in a miniature alien terrain. “Angus wanted this pullback, but he hadn’t shot any motion control elements,” said supervising compositor Ed



Cinesite supplied scenes inside the Houston launch dome as the Jupiter spacecraft, which will carry the Robinson family on its quest to find a habitable planet is readied for departure.



The launch dome opens just prior to takeoff.

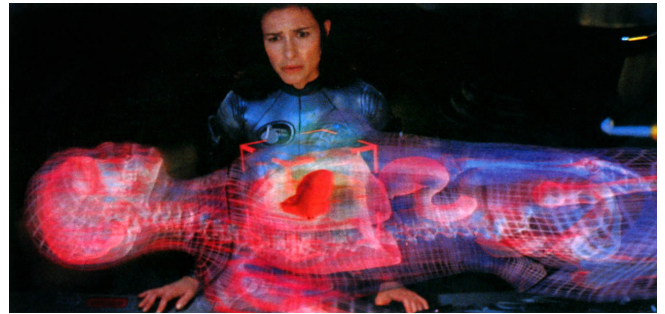
Hawkins. “He only had these still photos he’d taken on the backlot during a lunch break. So we created the whole thing from scratch, scanning the photos and doing 2-D morphing and warping in Inferno. We also had a four-perf element of Matt LeBlanc that went into an anamorphic bridge plate that, in turn, went into the Vistavision pullback plate we created. We then imported everything into Cineon, adding digital lights and smoke, and a 2-D element of the blast doors closing over the bridge windows. The scene ended with a cross-dissolve to a high-resolution matte painting of the J2 nestled in the crater wall.”

While most of the Jupiter 2 elements were shot with the motion control hero model, a CG version was created by Electric Image for such scenes as the sabotaged ship flying dangerously off-course. “It may be a beautiful spacecraft, but there’s not one regular surface on it,” observed Electric Image animation head Simon Maddocks. “The Jupiter 2 eventually weighed in at about 1.7 million polygons – one of our biggest models to date.” The ship was modeled in Alias Wavefront Explore 3-Design, with hundreds of textures applied to produce the final look. On some shots, Electric Image composited its high-resolution spaceship model into CG backgrounds or miniature settings. For others, it supplied ship images for outside compositing.

Peter Rubin’s previsualized Jupiter 2 also came in handy when Bickerton decided to set up an internal CG department “I thought that to sweeten some shots – doing things like adding an extra CG ship buzzing around the launch dome – we would create those elements ourselves and furnish them for compositing,” Bickerton explained. “To create the digital Jupiter 2, we photographed our six-foot hero model – top and bottom, front and back – and then mapped those photos onto Peter’s wire-frame. So if we did not have a motion control Jupiter 2 element for a particular shot, we could render and animate one in our production offices and give it to one of the companies for compositing.”

As with the TV show, Dr. Smith commandeers and programs the mission’s robot for evil – until young Will Robinson (Jack Johnson) wrests back control and reprograms it for good. The robot would have two design incarnations – its original high-tech form, destroyed by alien spiders encountered on a derelict spaceship, and its rebuilt design, inspired by the bubble-headed TV robot. Both would be built by the Henson team.

For Jim Henson’s Creature Shop, renowned for muppets and other cuddly creatures, the robot was a significant creative departure. “This was a real robot,” stated Henson creative project supervisor Verner Gresty, “so everything you saw it do on film, apart from its computer generated laser blasts, it was doing for real. The robot’s moves were powerful, but smooth and fluid. Most of the internal



A medical scan – created by FrameStore – was among the holographic displays seen aboard the Jupiter 2.



Shots of the Jupiter 2 approaching the Proteus – built by Magic Model Company – were produced by Men in White Coats.

architecture was aluminum alloy, with external body parts of fiberglass. We made pattern molds as you would for an automobile, and finished off all the curves and shapes by hand. Then we made silicone molds off those and vacuformed them.” The first robot – nicknamed ‘Big Blue’ – was almost nine feet tall, weighed a ton and a half, and had about sixty hydraulic control channels. “Its upper body was able to swivel 360 degrees and tilt forwards and backwards. All the big moves were hydraulically powered with servo valves running through a computer controlled system. The rebuilt robot weighed three-quarters of a ton and was compressed to six feet. The base, which was the same for both, allowed the robot to move freely up to twelve miles per hour – although for some shots we placed it on a track.” Robot animation generally involved four animators working a bodysuit rigged with potentiometers corresponding to the various components. “The beauty of the waldo rig was that we could record and play back every move at a variety of speeds for the director’s approval. That was particularly invaluable in safely programming robot moves involving stunt performers.”

Henson’s robot also marked the company’s first use of computer aided design and cutting technology for an entire creation. The shop took Norman Garwood’s two-dimensional art department designs and, in CAD, developed the physical specifications for both robots before making a single one of the three thousand individual robot components. “Normally we’d have a whole team of people sketching things out, testing as we went,” Gresty noted, “but by going into the computer first, we saved time and also achieved the kind of precision we needed.”

Effects enhancing the robot included a hand-painted particle beam created in Matador by visual effects co-supervisor Steve Begg. But the wildest visual was a holographic representation of Big Blue being remote-operated by Will Robinson from the Jupiter 2 as the physical robot fights metal-chewing alien spiders on the derelict spaceship – with the spiders also represented as holographic icons. In fact, the robot holograms were part of a fantastic future in which the 3-D images are utilized in everything from medical scans to on-board navigational displays. “Holograms are usually presented as degraded visual noise; but in this world, there are different holographic devices and an entire palette of holographic appearances,” related Robert Duncan, senior digital effects artist at FrameStore, where the effects were designed. “There’s a culture of holograms ranging from lower-end generations to the perfect holograms aboard the Jupiter 2.”

“We did a lot of work on shaders to get the feel of a hologram,” added FrameStore 3-D head Andy Lomas, “particularly what I call a ‘shadow tracing’ technique that made it relatively easy for the animators to specify areas they wanted to appear and disappear on the holograms. As we moved these shadows through the hologram they would automatically rez up or rez down. So, as the holographic robot is seen battling holographic spiders, and as the robot is damaged, those pieces of the hologram start disappearing. We used Mental Ray for all the 3-D rendering; but we weren’t happy with the way the motion blur was working, so we created our own motion blur system. Like RenderMan, Mental Ray has shaders that allow you to hook your own code right into the core of the renderer.”

The vicious alien spider swarms were a surprise awaiting inside the massive hull of the Proteus, a mysterious, deserted ship as lost in space as our heroes. Magic Model created the ship as a twenty-nine-foot motion control model equipped with an array of internal light sources. “The Proteus was shaped like a lance with a six-foot-diameter ring towards the back,” stated Jose Granell. “The whole

thing was encrusted in cathedral-like etchings we created using acid-etched brass sheets. It was so littered with detail you could barely touch it.”

Shots of the Jupiter 2 approaching the derelict, as well as a later one of the Proteus exploding, were created by Men in White Coats, one of the Domino houses. In the compositing process, film negative was scanned while 3-D elements – background star and planet plates, plus nebula and asteroid effects – were provided on high-capacity disk drives and transferred to Domino via Quantel’s Quicksilver NT network interface. The resulting composites were output with a Domino recorder.

“The foreground Jupiter 2 and Proteus spaceship elements were motion control models shot at Shepperton,” explained MIWC digital effects coordinator Steve Shaw. “Each spaceship was made up of multiple layers – beauty pass, key light pass, fill light pass, practical lights, engine lights and so on. Using Domino to composite all of those layers enabled the relative color and brightness of each to be mixed and manipulated, along with added spotlights and other elements. The Domino system has a closed-loop calibration enabling the digital material coming from different facilities to be scanned or output at other Domino locations without any worries about calibration or density. Via Quicksilver, varying file formats could be imported and exported at various resolutions without image degradation. We utilized Domino to produce more than fifty complex shots in just over a month, with no more than five operators, thanks to the system’s real-time, full resolution and color film playback.”

The deadly spiders lurking within the Proteus were created as 3-D animated creatures and composited by Film Factory, the digital effects features division of VTR, a commercials post facility. Even spiders blown up in battle were digital, with added practical paint splatter elements color corrected to suggest blasted spider blood. With their crustaceous exoskeletons and fangs that could heat up and chomp through metal, the swarming creatures were a fearsome presence. “The spiders appear in one long chase that begins as we see one spider, then another, then a dozen, and then hundreds,” explained Phil Johnson, Film Factory’s senior 3-D animator who supervised the fifty-shot sequence. “We did the spiders using Alias, in which you can write mathematical formula to link objects together. Originally we were writing a lot of expressions to control their moves. We looked at all sorts of stuff: particle replacement spiders, having body positions calculated by the position of the spider legs, having a lead spider drive a particular group. In the end we simplified the model and controlled a lot of the animation by hand, with the most complex, high-resolution spiders in the forefront and low-rez models with twenty percent less information in the background. We also built control systems into the spider mouth so that the fangs could open, flex and chomp. On the user interface we had a little slider box to change values. At zero, the mouth would be closed; at one, it would be completely open. So just by moving the slider we could effectively animate the mouth.”

In counterpoint to the alien arachnids was a whimsical, two-foot-tall baby monkey/reptile that the space travelers discover within the Proteus. The creation of ‘Blawp’ was assigned to Jim Henson’s Creature Shop and represented the first major CG feature animation assignment for the firm’s computer graphics department, established in 1995. Ironically, Henson had built an animatronic Blawp initially, when the intent had been to represent the creature with twenty-five CG shots and fifty physical puppet shots. But the animatronic Blawp rendered itself useless when the decision was made to do the entire sequence with computer animation. “The animatronics puppet just

wasn't as flexible as the CG creature," noted Henson CG supervisor Hal Bertram, "but we could bring our CG version closeup on screen and it still looked attractive."

Henson artists utilized a Cyberware scanner to input the basic structure of their Blawp sculpture. Using the scan as reference, a virtual version was built up into a character capable of producing more than three hundred facial movements and limitless combinations thereof. The creation was composed of 209,000 polygons, its skin layered with nine different texture maps ranging from transparency and specular maps to bump maps for a leathery texture. Most important of all, the Henson team used its proprietary Henson CG Creature System software to build an integrated skeletal/muscular system that would enable the animators to create specific physical behaviors.

The most complex Blawp shots began with pencil animation line tests drawn by Passion Pictures, a traditional cel animation house in London. After the artists drew their pencil animation over frame-by-frame background plate printouts, the artwork was returned to Henson's for scanning and use as a guide for rotoscoping in the 3-D Blawp. Character animation, particularly facial expressions, was generally accomplished by supervisor Mak Wilson, who puppeteered the CG creature in real time using a virtual extension of the Henson Performance Control System – the computerized puppet-control system that has been an integral tool at the company since 1985. While the massive Big Blue robot needed four waldo-equipped puppeteers to control its movements, the Performance Control allowed a single puppeteer with electronic hand controls to manipulate a creation, the system providing the same interface no matter what the animated subject – in this case, a 3-D alien creature existing in the virtual realm.

"There's no real difference between using this system to control an animatronic puppet or a digital creature seen just on a monitor," said Bertram. "As with a real puppet, there's the equivalent of physical actuators, except in the CG world you can control much more than in the animatronic world. I think one of the reasons we went with this system for Blawp is that the character did not have a standard CG creature anatomy. We had provided it a real skeleton and muscles, rather than just skin around a random skeleton, so it would behave more like a real thing."

In the finale of the Proteus sequence, the drifting starship explodes, spiders and all. To create the pyrotechnics, Magic Model built a pyro model in steel to accommodate multiple takes. For the night shoot, the huge model was suspended from four thirty-foot towers erected on the Shepperton backlot. A special motorized camera dolly was built to travel backwards underneath the model at forty miles an hour, triggering pyro switches lining the track as it rushed by. "To give weight and scale to the



Inside the Proteus are swarms of deadly spiders created digitally by Film Factory.



Also discovered inside the derelict is Blawp – the first major CG character created by Jim Henson's Creature Shop.

explosions, the dolly was equipped with a highspeed Photosonics camera so we could shoot at 360 frames a second,” Granell remarked. “Because we were shooting at such a high frame rate, we actually had only a second and a half to travel the distance we needed.”

The Proteus explosion creates a blast wave that knocks the Jupiter 2 into the atmosphere of a nearby world, the ship finally crashing in a snow-covered wilderness dominated by mushroom-shaped trees and a yawning crater. The actual crash was an example of classic television inspiring a modern big-screen effect. “The original TV show’s crash-landing utilized classic Lydecker techniques,” commented Bickerton, “and some of those shots hold up today. We literally said, ‘We can’t beat this.’ We wanted to carry on that spirit and do the same thing. So for the crash approach we actually flew the J2 model on wires on the Shepperton lot, backlit against the sun. Of course, we had the advantage of being able to digitally remove the wires.”

The crash sequence, with Steve Begg directing, began with the approach down an eight-foot-high, hundred-foot-long ramp. The impact itself played out in numerous cuts across a Magic Model landscape. “The planet set at Shepperton was 150 feet wide and 100 feet in depth,” Granell related, “with the front end a foot off the ground and the back end about ten feet off the ground. Because the sequence had so many different shots and viewpoints we built lightweight steel frameworks for the landscape at varying scales, with the actual texture first sculpted, then molded and applied in plaster. Building the landscape in different scales, with huge foreground mountains diminishing in scale towards the back, created a forced perspective and the look of a vast terrain. For a dense, forested look we made thousands of stylized trees, from five-foot models to tiny pop-up trees complete with ground texture that we cast and laid out in three-by-two-foot latex sheets.” For the crash, Granell used an off-road vehicle to pull the model through the set on cables. “The cable generally ran through the nose of the ship; but because the model was being pulled through a snowy landscape it virtually disappeared. The snow was powdered paper, with salt used for kicks and glistening effects and breakaway ice shards for when the ship bounced across the landscape.” Digital tools allowed once-impossible image processing tweaks. When a too-big chunk of breakaway ice betrayed the scale in one shot, Cinesite erased the offending fragment and digitally added dust cloud effects.

The alien world on which the ship crashes is a psychologically jarring place of time portals where some of the space voyagers encounter their future selves. But the glittering starfield above the alien world did afford the Jupiter crew moments to glory in the wonder of it all – most romantically, Don West and Judy Robinson (Heather Graham), gazing out the bridge windows. The thirty-eight-shot sky-watching scene was completed by Computer Film Company which, although already committed to other films such as *The Avengers* and *Snake Eyes*, did not want to miss out on the *Lost in Space* experience. Digital artists Tom Debenham and Adrian De Wet went to work on the scene, which entailed compositing footage of the actors photographed on a greenscreen-backed bridge with a panoramic digital matte painting of the nocturnal landscape, window condensation and starfield elements.

The live-action featured wild camera moves; but thanks to in-house tracking software, CFC had no problem marrying the shots. “With the software’s automatic tracking,” commented Debenham, “we can scan in an image and the computer can pick up any point of detail and, as the camera moves

around, stay locked onto that detail with the appropriate parallax so it looks natural in the environment. There's no encoding from the camera at all. It's based on the live-action itself."

On the planet is a pulsating dome through which time portals provide passage to the future ruins of the Jupiter 2 wherein an older Will Robinson has fashioned a time bubble from the surviving hyperdrive engine. A Cinesite team led by digital effects producer Deanna Gould, technical supervisor Ken Dailey and supervising compositor Ed Hawkins created the time effects and was closely involved with Stephen Hopkins during the design stage. A particular challenge was coming up with a look for when various characters walked through the time portals. "The director specifically did not want a watery look," stated Gould. "He wanted the shapes to be hard as opposed to the rounded, organic ones found on the planet." The final effect would have the look of fracturing glass.

To achieve the time passage effect, the digital artists took live-action of the performers shot on a soundstage set and put those elements through a 2-D digital distortion created in Cineon. "When, for example, John Robinson and West walk through, we first rotoscoped them off the plate," Hawkins explained. "We had built some simple black and white shapes in 3-D, which we used as mattes and put through a glass refraction tool in 2-D, creating a series of animated textures that acted like different thicknesses of glass and refracted the image of the actors passing through it."

The time bubble within the future Jupiter 2 hyperdrive engine was a vertical tunnel dropping to a ring with a magical looking-glass view to the past – revealing images of the Jupiter launch and hypergate construction site, elements provided by the various companies – which would gradually come into focus as the time traveling device came up to speed. An additional maelstrom of sharp-edged chunks and gaseous elements swirling within the ring was produced at Cinesite by sequence supervisor Chris George, who created the effect in Alias Dynamation.

The live-action set of the converted hyperdrive engine had a vertical greenscreen into which the digital effect of a lowering time bubble was added. In consideration of postproduction concerns, a practical ambient light effect was incorporated into the live photography. "The time bubble was supposed to be giving off a huge amount of light," noted Ken Dailey, "which was created by lowering a large helium balloon into the set with a practical light inside. We put our CG time bubble over the helium balloon, which made it look as if the CG was lighting the live-action."

In this time-out-of-joint world, our heroes encounter a future Dr. Smith horribly mutated into a gigantic half-human, half-spider creature, the consequence of a spider scratch suffered during the Proteus episode. 'Spider Smith,' as the creature was dubbed, was a nine-foot-tall virtual character who had to perform and interact within a live-action environment. Since Film Factory was handling the synthetic spiders, the company also took on Spider Smith. To minimize CG number-crunching, and to add to the surprise, the hulking Spider Smith would be introduced concealed in a hooded cloak, with



only the face visible prior to a stunning reveal. The original plan then posited creating a CG neck and body and attaching it to Gary Oldman's face, which would be transformed by prosthetic spider makeup.

That plan was abandoned when Oldman chafed at the five-hour makeup sessions and the director felt the prosthetics would hide the actor's performance. "Going the CG route for both the head and the body really made life easier," admitted CG supervisor Lee Danskin, "because we had a whole creature to animate, rather than worrying about matching a CG body with the real Gary Oldman."

To capture Oldman's every facial nuance, and to accommodate the tight time schedule, it was decided to create Spider Smith's face with motion capture. "We settled on a 3-D software called Motion Analysis," remarked Danskin, who headed up the motion capture sessions at Shepperton. "We did a couple days of tests with a stand-in; and then, for three days, we had Gary going through the entire sequence. He would sit and act while six cameras picked up the thirty to forty sensors on his face. We tracked a meter-square area around Gary's upper body which gave him the freedom to do his performance. The actual model was then created in Power Animator, which had been fed extremely raw motion capture data in order to retain as much of Gary's action as possible."

In a grand finale, the expanding time portals finally shake apart the planet's foundation. John Robinson's novel idea of flying through the disintegrating world allowed for a fantastic trip past tectonic plates, waterfalls, fire, and out through a volcanic cone to safety. "The journey through the planet utilized miniatures, with the odd bit of CG thrown in," explained Rob Duncan, who supervised the end sequence at FrameStore. "Then, when the planet exploded, it was all CG. Most of the flying rocks that needed to be choreographed to the ship we built CG, with some bluescreen rock elements for background debris."

Towards the end of production The Mill, another London facility, handled a number of spillover compositing shots, with additional comp work taken to Toy Box in Canada. To move data to and fro, the production relied on Soho Net, a fiber optic link connecting London's effects facilities. Then there was 'Runner Net.' "We could just take a tape and walk it a few minutes down the road to the next facility," Angus Bickerton laughed.

That atmosphere of convivial teamwork, which included festive weekly group screenings of work-in-progress at Cinesite, helped carry the day. "There was no rivalry," Bickerton concluded. "Everyone was keen to see what everyone else was doing. To meet a schedule and get out a lot of shots can

A spider bite sustained by Dr. Smith turns the nefarious saboteur into an arachnid humanoid, created digitally by Film Factory.



The Jupiter 2 crash-lands on an alien planet where time portals – created by Cinesite – propel John Robinson into the future.



As expanding time portals shatter the planet, the Jupiter 2 dives through it in a sequence by FrameStore.

become a bit of a mill; but thank goodness for all the individual talents and companies who added something extra. It became like one big company, in a way. It was quite an odyssey.”

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DEEP RISING

HORROR ON THE HIGH SEAS

An ocean liner – one of the largest and most opulent ever built – meets a calamitous end on its maiden voyage. While that premise may have a familiar ring, what spells doom for this particular vessel can hardly be mistaken for an iceberg. In *Deep Rising*, a horror-thriller written and directed by Stephen Sommers, a gang of modern-day pirates intent upon looting the cruise ship *Argonautica* sneak on board, only to find it eerily deserted. Suspecting that something more nefarious than larceny has befallen their intended victims, the pirates soon find confirmation as their own numbers are diminished by attacks from an array of giant fanged tentacles, ultimately revealed as extensions of a behemoth sea monster risen from the deep.

Development of the film under the auspices of Hollywood Pictures would lead Sommers to Dream Quest Images, the visual effects division of the parent Walt Disney Company. Dream Quest visual effects supervisor Mike Shea embraced the opportunity to delve into computer generated character animation for the film's creature, but recognized the need to pare down the initial effects-heavy script. "When we first came on board in October 1995," Shea recalled, "there was a draft that called for some 500 effects shots. We were able to advise Steve in terms of what could and couldn't be done, and assist with some of the script rewrites."

Joining those early strategy sessions was veteran makeup artist and Academy Award-winning creature creator Rob Bottin, whose job it would be to oversee makeup effects and translate Sommers' ideas for the sea monster into a cohesive design concept. "Rob created a half-scale maquette of the creature that was about eight feet tall," said Shea. "That, along with a videotape and some examples that we had done at Dream Quest, ended up being the pitch tool that was presented to Disney studio chairman Joe Roth to show him what we thought this creature would look like, how it would move and why he should spend a lot of money on an octopus tentacle that basically chases a bunch of people down a hall."

While design issues were being addressed, Shea began gearing up for the challenges that lay ahead. To prove the viability of a CG approach, a team led by digital effects supervisor Dan DeLeeuw and CG creature supervisor Rob Dressel spent months conducting research and shooting an elaborate proof-of-concept test. "We were expanding our studio at the time," recalled DeLeeuw, "and we had a room that wasn't done yet, with a bunch of exposed pipes that proved ideal for simulating the ocean liner's engine room. We went in and gooped it up and shot that as a background plate." Working with a preliminary design for the creature, animators devised a short scene in which a CG tentacle, coiled around a pipe, dropped down and dove at the camera. "It took quite a long time to get that test done," said Shea, "but I think it was a turning point for Steve. It was like: 'Well, okay. Now I know what I'm getting into.'"

ARTICLE BY ESTELLE SHAY

In fact, the test proved so encouraging that Sommers reevaluated his intended strategy for creating the sea creature with a heavy emphasis on latex and animatronics. “When we started, we were looking at producing a digital version just for distant views and shots involving a lot of movement,” noted DeLeeuw. “The idea was that our work would be complemented by some kind of practical rig – an actual twenty-foot-long tentacle that they would have on set – for all the closeup stuff and for any scenes involving interaction with the actors. But as we progressed, and the production began weighing the costs of building and shooting a full-size beast on set, everything started to go digital and we ended up taking on the preponderance of the creature work.”

Since the script offered little in the way of detailed information on the creature, Bottin and the digital team – envisioning a blend between the tenacious, striking characteristics of a snake and the globlike, gelatinous feel of an octopus – perused reptile and marine life references for behavioral clues. “We were really inventing a new organism,” said DeLeeuw, “so we needed to have a history for it.” One source that proved pivotal was a National Geographic video titled *Incredible Suckers*, which contained rare footage of a deep-sea organism known as a vampire squid. “It had webbed tentacles, and, for self-protection, could actually turn itself inside out by opening up its web and wrapping it around its head.

Instead of suckers, it had little teeth; so when it opened up, it turned into a giant ball of fangs.”

Having evolved through numerous iterations, from arachnid to crustacean, the final rendition of the creature incorporated characteristics of the vampire squid – specifically in the head on the end of each tentacle, which was sculpted by Bottin in three distinct poses. The first was a benign pose, with a long, fixed tentacle ending in a maw that closed like a flower bud so that just the outer surfaces of the mouth were visible, with teeth interlocked. A second, in-between head consisted of the tentacle in an open-repose position, showing both the outer geometry and the inside lined with teeth that could peel back to reveal the full attack head. The final pose was the full attack head, which had four large mandible-like claws, eight smaller ones and an internal jaw that could extend out.

Maquettes for each of the poses were scanned, and the resulting data manipulated in the computer by Dream Quest to construct 3-D models. “We found a scanning tool that would get us down to one



In Deep Rising – written and directed by Stephen Sommers – an enormous sea beast with fanged tentacles rises from the deep to wreak havoc on the luxury ocean liner Argonautica. The creature – designed by Rob Bottin – was brought to life via computer animation at Dream Quest Images.



Visual effects supervisor Mike Shea prepares to photograph a miniature set representing the corpse-strewn cargo hold of the Argonautica.

millimeter scanning credit,” explained Shea, “which allowed us to capture all the intricacies of the original clay models. One of the things we had done during preproduction – while still under the impression that we would be matching our creature to an animatronic counterpart – was develop a way to use all the scanning data so we wouldn’t have to regenerate everything Rob was doing.”

Photographs of the detailed sculptures were also scanned into a 3-D paint program to serve as reference for John Murrah, who was in charge of the beast’s elaborate textures and paint work. To achieve a slimy, organic look for the fully-rendered creature, digital artists employed Alias Wavefront shaders to layer in several different hand-painted textures. “With CG, anytime you want something shiny,” observed Dressel, “you have to beware of the curse of the plastic look. So we utilized a base layer to define the color and contours of the creature, and then a second layer to define the specular light that shined off it and to add additional texture.” Warp lights distorted the geometry, moving the skin slightly to enhance the illusion of a gooey, oozing surface.

Well before the creature designs were locked in, animators began experimenting with movement. Working in Alias Wavefront Power Animator, they used a serpentine skeleton in the form of a long chain, or spline, moving in a fluid fashion. “With a spline,” stated Dressel, “the control points serve as animation handles. As we move the handles around, the spline changes shape and can be put into very exacting poses. But with a spline, there is no fixed length. As soon as you move a control point, the length of it changes – it’s an infinitely stretchable entity – whereas our creature was not. Although there was some stretching and compression, it had to feel solid and heavy and grounded. So our animators had to be very aware of that and keep the volumes and mass and length of the creature the same as they worked through it.”

The animation was further complicated by the dichotomy inherent in the nature of the creature envisioned by Sommers. Throughout the script, the director had played up the beast’s ability to alter its shape and size, implying that while it was large enough to stop a thousand-foot ship, it could also squeeze itself down to half its size, passing through narrow corridors and kitchen vents. “We spent a lot of time developing a way to do that,” remarked Shea. “One of the biggest issues we fought all the time was the speed at which the creature was moving. We needed to give it weight and muscle; but we also needed to make it fast – a factor dictated at times by the sequence of practical effects that was happening on set.” To help determine weight and speed, as well as consistency of motion, creature animation consultant Chris Bailey was brought on midway through the project. His main focus was to keep the creature animation loose and heavy, while still allowing for movements that were dynamic and tenacious.

On hand for the start of principal photography in Vancouver were Shea and motion control operator Kevin Fitzgerald, who gathered measurements and encoded camera data from the shoot. The data was then loaded into Dream Quest’s computers so that digital artists could build virtual sets in order to match the creature animation to the live-action. Complex lighting and smoke effects contained in the plate photography were duplicated by CG artists Freddi Rokaw and Teresa Williams. “All of the hallways had overhead spotlights beaming through the smoke, which created a god-ray effect,” Dressel explained, “and the beams were filtered through a catwalk grate. So we had to match the look of the beam, then render our creature in it to generate a pass that gave us shadows in those lights. Our compositors would then use that pass to darken down the plate.”

Concurrent with the creature effects work was an equally ambitious undertaking led by miniatures art director Mike Stuart and model shop supervisor Jim McGeachy. The miniature unit's first task was to create an underwater landscape for the opening title sequence – a traveling shot through a debris field of old bones and sunken ships and into the mouth of a cave. “We knew this scene had a lot of importance in that it set the mood for the entire picture,” stated Shea. “The idea was for the camera to fly over this spooky underwater environment, teasing the audience that there was something big lurking there.”

Working with animatics to plan the flyover, Stuart designed and fabricated a thirty-by-forty-foot underwater landscape, with fifteen-foot-tall cliffs. Later, the model department would add shipwrecks in 1/24- and 1/32-scale, including replicas of a freighter, an old galleon and a submarine. The set was dressed with various smoke densities and filmed dry-for-wet on a motion control stage. To suggest the creature's point of view, portions of the shot were slowed down or sped up for a kind of fisheye look, while digital blur and cavitation effects, added later, imparted an otherworldly feel and the suggestion of rippling water.

Over a period of months, the concept for the opening had undergone revisions as both the budget and script were tightened. Eliminated from the final movie were additional expository elements filmed to support a backstory conceived by Sommers as a rationale for the creature's emergence from its lair. “In the backstory, the French are doing underwater nuclear tests in the area,” elaborated Stuart. “When the explosion happens, the submarine wreck is lifted off the ocean floor and tumbles into the mouth of the cave, waking the monster and bringing it to the surface.” For these scenes, modelmakers built a second ocean floor miniature, rigged with breakaway bones and air mortars to simulate the underwater nuclear shockwave. “We were just completing the very last shot in that segment when the whole thing was pulled,” remarked Shea. “It was unfortunate, because a lot of work went into it. I had a CG team – Deborah Wiltman, Bruce Tartaglia and Michael Kuehn – who worked for a year on the sequence, and all of their stuff got cut.”

Miniature work would also figure prominently in shots of the Argonautica. Since no such vessel existed in real life, a highly detailed, motion control model was built in 1/30-scale for establishing shots of the Argonautica on stormy nighttime seas. Dream Quest modelmaker Matt Suzuki developed designs for the ship in collaboration with production designer Holger Gross and art directors Kevin Ishioka and Sandy Cochrane. McGeachy and lead modelmaker Ray Juncal guided the three-month-long model build. “We constructed a steel frame interior on wheels,” stated Stuart, “so we could roll it around on stage to position it to camera. On top of that went layer upon layer of plastic and wood and castings to build up the hull and the exterior details.” More than a thousand miniature lights illuminated the 36-foot-long construct. Mylar and reflective material, positioned in front of the ship during the stage shoot, simulated water reflections on the hull. In postproduction, synthetic stormy skies and digital ocean were inserted to complete the illusion.

In addition to the hero vessel, a larger, less-detailed model, measuring 110 feet from bow to stern, was built for a climactic scene in which the Argonautica explodes and sinks. Modelmakers constructed just the starboard side of the vessel, with a slight bit of wraparound to cover camera angles. Equipped with a steel subframe that could be articulated into a sinking position, the model was clad in prescored plexiglass and packed with debris. Scale lifeboats, life preservers and other paraphernalia adorned the exterior decks.



The gruesome sight of a victim – partially digested by the tentacled beast, but still alive – was produced by Blur Studio.

Deep Rising opens with the Saipan, a boat-for-hire captained by John Finnegan (Treat Williams), tossed about on the stormy South China Sea while racing to intercept the Argonautica. To establish the ocean liner, a push-in was accomplished using two different scales of ship model, shot motion control by director of photography Scott Beattie. “We started off with the hero model,” stated Shea, “but for the closeup view, where you see a man on deck, we built a sixth-scale, twenty-five-foot section of just the deck and railing, and tracked that into the scene along with greenscreen footage of the actor. It was a tracking nightmare for our 2-D compositing supervisor Blaine Kennison and compositor Jep Hill.” Added in postproduction was digital water surrounding the ship and a synthetic sky consisting of real sky mapped onto a CG sphere. As the camera continues pushing in, it follows the passenger as he turns and enters the ship’s atrium, where a party is in progress. First unit filmed on a three-story atrium set that had been built ten feet from the side of a stage wall. “We cut out a large chunk of the stage wall,” said Shea, “and double clad the set to build just the mezzanine on which the actor was standing. Then, with the camera on a crane, we moved with him as he entered.”



The full monster – unseen until late in the film – was another Dream Quest digital creation.

Unbeknownst to the partygoers, the Argonautica’s communications system has been tampered with by an onboard saboteur in cahoots with the high-tech pirates who have chartered the Saipan. For a series of shots depicting the sabotage act, the filmmakers turned to Banned from the Ranch. Under the direction of co-founder Van Ling, BFTR built a prop computer console and designed and created all of the insert shots, which had screen graphics fashioned by Sage Greco.

BFTR was also assigned visual effects on four other sequences in the film, including a *Jaws*-type POV as the monster approaches the underside of the ship shortly after the sabotage. “When the production realized what we could do,” related Ling, “they said, ‘We’d like to get a shot where you

don't actually see the monster, just a push-in towards the propellers that happens seconds before the thing hits.' With only a miniature of the Argonautica – built strictly for above-water work – at his disposal, Ling opted to produce the entire shot digitally. "We modeled portions of the ship that we wanted to see from underneath, and took some photos of it above the water, adapting the light patterns so we could map them onto our model. We used Areté Digital Nature Tools to create the underside water surface – but since Areté is really designed to do above-water effects, we had to figure out how to adapt it for underwater use. Gunther Schatz did the CG animation of the water in Alias, and ended up actually animating it upside-down, with the CG camera diving down toward the water surface. Then we flipped the orientation, so it looked like we were underneath, going up." Bubble elements and cavitation trails from the propellers were added, and the shot composited by Eric Ippen in After Effects.

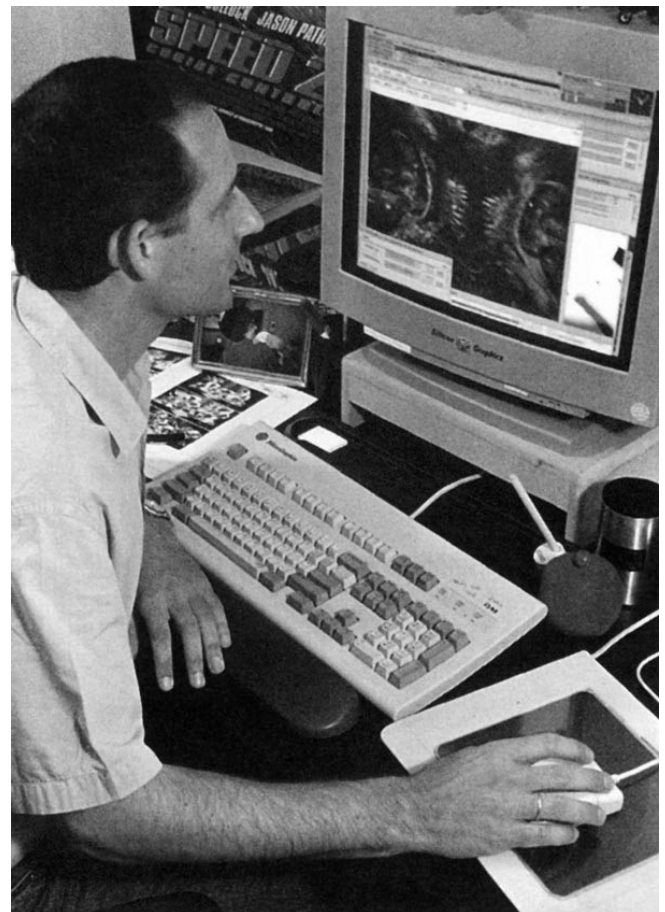
Upon reaching the Argonautica and boarding her, all the pirates find is a blood-spattered ghost ship and a handful of frightened survivors. Before too long, members of the pirate crew begin to disappear, as well. The cause of the mayhem is revealed when a giant tentacle is spotted descending from the ceiling behind Saipan mechanic Joey Pantucci (Kevin J. O'Connor). As the heavily armed pirates open fire on a writhing mass of tentacles entwined in the rafters overhead, one is ripped open, releasing the still-living, but partially digested remains of Billy (Clint Curtis), one of the missing team members. The gruesome effect, produced with the aid of computer generated imagery tracked into a live-action shot, was the work of Blur Studio, founded three years ago by David Stinnett, Tim Miller and Cat Chapman – all alumni of Sony Pictures Imageworks. "The director wanted an effect that there was really no way you could do with just prosthetic makeup," explained Stinnett, who supervised the CG sequence. "In the scene, the character gets up dazedly and slowly turns around. You can tell he's in sad shape – he's got hair missing and slime all over him. But as he turns, you realize that half his face is also dissolved away, and one arm is full of holes." Working with PCs running Windows NT, digital artists at Blur replaced half of Curtis' head with a 3-D CG head, cut out so that the background could be glimpsed through parts of it. In addition, the actor's real forearm and hand were substituted with a CG version, also eaten away and riddled with holes. "We were supplied with plates of the actor screaming and lurching towards camera, and with data derived from sculptures – done by Rob Bottin from lifecasts of the actor – that we scanned into the computer. We basically rebuilt the head using that data as reference, and chunked out the skull so you could see through the bulk of it. Once we had that in the computer, we had to track the head to the actor – which was really difficult because the plates had been shot with no tracking points and the character was really spasming and shivering. So on any given frame, his face was really blurred. We ended up having to go in frame by frame and move the CG head to match the rotations and positions of the actual head. Once that was done, we made sure the lighting, color and texture of the CG head matched the real one, and also matched the motion blur that was in the background plate. Then we did the same thing for the arm."

For bullet hits on the surface of the CG tentacles in this and subsequent scenes, Dream Quest devised a mix of digital and practical effects. "Mike Shea shot a whole series of different exploding goo shots from every conceivable angle and size," said Dressel, "which gave our compositors a palette of gore that they could bring into a shot and pick whatever looked best. But those were very liquidy, and Steve wanted to see more; so on top of that we added CG chunks of flesh flying off the

creature. One of our technical supervisors, Rob Clegg, was our chum guy. The hard part was that all the guns were these high-powered, super-automatic rifles that supposedly fired hundreds of rounds per second. So Megan McBurney, who did the 3-D bullet hits, would map out along the creature's body and head where the hits came and when. Then we wrote a system to develop animated texture maps that would create wounds appearing at designated times and in designated parts of the body. Jen Howard also added blood spatters to the bullet hits with practical elements."

As the terrified humans scatter, the ravenous tentacles ambush them at every turn. In one instance, Hanover (Wes Studi), one of the pirates, is thrown onto a roulette table and devoured whole. The interactive creature effects, done primarily by Dream Quest, required precision tracking on the part of the digital team. "For that scene we were given a background plate of the actor on the table," recalled Dressel, "and we had to rotomatte our CG creature into the scene, wrapping it around him at the waist and slowly working it up his body. The difficulty was not only getting the creature tracked and wrapped around the character properly, we also had to warp it to make it look like the tentacle was stretching the way a snake does as it envelops its prey. Like a big wave, a bulge surges up the creature and, almost like a caterpillar, propels him up and over. We used a kind of CG mannequin to define the shape of the tentacle and track it in where our guy was." In another ambush – this time in the ship's kitchen – a tentacle pops up unexpectedly to grab another victim, plunging down from above to engulf him all the way to his waist, then thrashing him about before swallowing him whole. "We rotoed the actor out of the frame at the point where the creature came down on top of him. Then, when he was lifted off the floor, we replaced him with CG hips, hands and legs."

Herded toward the bow of the *Argonautica*, the survivors stumble upon the missing passengers and crew – reduced to a mass of bones and gore piled high in the ship's cargo hold. To film the sequence, the Dream Quest model shop built a miniature of the hold, thirty-five feet deep and approximately fifteen feet high, with different levels, mezzanine, catwalks, pipes and various-scale lighting. "We molded up tons of miniature skeletons," remarked Stuart, "and used all kinds of weird formulations of goo to match the full-scale corpses that first unit had made. Then, since the ship is carrying cargo to different ports, we made lots of cargo containers, miniature boxes with breakaway contents and miniature forklifts." For a followup scene in which the hull is ripped apart, causing the ship to flood, the miniature set was transported to the parking lot of a nearby school and flooded. "We rigged the set with a water drop that, upon command, released a torrent, destroying the breakaway pieces and tossing skeletons around."



While Dream Quest would oversee the majority of CG creature effects, one notable exception was a scene in which Finnegan and surviving passenger Trillian (Famke Janssen) perform a daring escape on

a jet-ski down a narrow water-filled hallway. The sequence was one of several relinquished to Industrial Light & Magic in an effort to ease the burden of an expanded workload and an abbreviated post-production schedule. Under the guidance of visual effects supervisor John Berton, ILM had just three months to ramp up to speed in terms of the complex creature animation. “We were assigned eleven or twelve shots altogether,” recalled Berton, “in four different parts of the film. The biggest was the jet-ski episode, in which there were five or six tentacle heads ripping down a flooded hallway toward Finnegan and Trillian, who pick them off, one by one, with a shotgun. So there’s a lot of action, with the tentacles chasing, being shot, reacting to being shot, retreating and reappearing around another corner, then chasing again. Finally, our heroes escape by closing a door that prevents the last of the tentacles from following them. It tries to stop and plows into the door.”

The ILM mandate was to precisely match what Dream Quest had already accomplished in terms of the CG creature. “We were really keying off the work that Dream Quest had done to make sure our stuff fit,” acknowledged Berton. “We got information about what color palette they were using for their texture maps, and we applied the same information they had used to build their original models. Then we looked at final film frames to figure out how we could match them with our own techniques.”

One ever-thorny problem was the presence of water in the shots. “Water is, historically, one of the most difficult things for a visual effects artist to work with,” related Berton. “It’s very hard to get it to look right – whether you’re using photographed elements or CG water – because there’s so much physical interaction in the droplets. We found that a combined approach worked best. We wanted to have the water elements tied closely to the creature animation – when the creature smashed down, we wanted water to fly out directly. Since that required a procedural computer graphic solution, we took a particle systems approach, with a lot of 2-D image processing over the top of it to enhance the watery look. But there was still a level of complexity missing. One of the things we’ve learned to do quite a lot is find ways to mix live-action photographed elements with CG elements to get the best of both worlds. So once we knew where the water elements needed to go in any given frame, we filmed some practical stuff – basically water splashes against black backgrounds – and put those in on top of our particle animation. Then compositing supervisor Scott Frankel – who was responsible for the water interaction stuff – came up with image processing techniques to merge them together to look like one big element.”

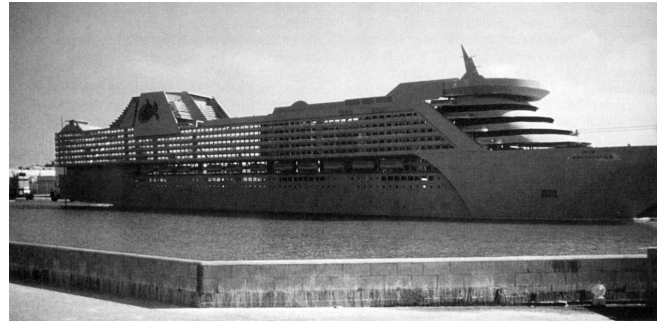
Computer graphics supervisor Scott Frankel studies a shot in one of the overflow sequences apportioned to Industrial Light & Magic.

Animation supervisor Dan Taylor guided the performance aspects of the tentacles, again making sure that they matched the feel of the Dream Quest work. “We looked at all the Dream Quest stuff to get a sense of what they had done mechanically with their CG form,” observed Berton. “Dan had a really interesting approach to animating the creature. We built a miniature tunnel in one of our rooms and he basically did stop-motion animatics of key scenes using a bunch of foam rubber armatured snakes. That served as a training ground for all of our animators, and was a lot faster than trying to manipulate a great big complicated creature model in a computer environment.”

As Finnegan and Trillian race through flooded corridors, they come upon the vast atrium nearly filled by the gigantic head of the sea monster. The last of the beast to be revealed, the head was also the last of *Rob Bottin*’s designs to be pinned down. “We ended up having to shoot plates for that scene before we even knew what the head was going to look like or what it could do,” commented Dressel. When the head was finally approved, a sculpted maquette, with jaws wide open, was laser-scanned and brought into the computer. “No one knew how the mouth closed or what it did. So Eugene Jeong – who pretty much masterminded the big head model – added bone structure inside that worked like a human jaw, but with interlocking layers of teeth that made it look like a giant mouth from hell closing in from every corner.”

At the center of the big head was a monstrous eye – a giant blue orb patterned after the eye of the vampire squid. Cold and dead-looking, with no discernible characteristics, it was surrounded by an eyelid that spiraled open and shut like the iris of a camera. Membranous intake and outtake valves on the side of the head opened and closed like the airholes on an octopus – an effect accomplished with 3-D warping techniques. Warp lights in *Alias Wavefront Power Animator*, applied to the entire head geometry, gave the skin a soft and gelatinous look. No attempt was made to show how the tentacles connected to the head. “We did kind of a cheat – there’s a bunch of debris wrapped around the hole in the ship’s hull that the head emerges through, and the tentacles just curl up over the top of that.”

Finnegan is snatched up by one of the tentacles, swept across the chamber and dangled in front of the monster’s gaping maw. “That was one of our most challenging scenes,” said Dressel, “because we had to sell the fact that a CG creature was picking up Treat Williams. Shots of him getting picked up by the tentacle and thrown against a wall were actually done on set, with Treat lifted up in a crane. We did a clean pass so the roto team could take the crane out. Then we had to put the creature around him, warped so that it looked like it was actually gripping his body.” Bluescreen footage of the actor, shot on a stage in Vancouver, was used for closeup views of Finnegan



Needing wide shots of the Argonautica, Dream Quest constructed an enormous model and then blew it up for the film’s fiery finale.

confronting the head and firing a shotgun blast directly into the eye. The shattering of the CG eye was accomplished as a practical effect by blasting a methocel-filled latex membrane stretched across an eye-shaped opening in a piece of plywood. The element, filmed in slow motion, was then composited over the animated eye.

The film climaxes with the detonation of both the Argonautica and its monstrous marauder. To stage the massive blast, the 110-foot Argonautica model was carted to nearby Oxnard Airport, assembled on the tarmac and rigged with primacord and flame gags by pyrotechnics coordinator John Gray. A shallow pool was built in front of it to allow the miniature photography crew to capture interactive lighting and splash effects. “We had two key scenes that needed to be shot,” explained Shea. “One was the initiation of the blast, where we see just a portion of the ship exploding. The other was the whole ship breaking apart. In between those shots, Steve wanted to cut away to inserts of the jet-ski trying to escape and various interior sets blowing up. Rather than just trying to grab the first piece off the beginning of the big explosion, we said, ‘Let’s build some replacement sections, shore up the parts that we don’t want to explode, and blow it up a couple of times.’ So we built three replacements sections and did three takes on that initial shot. We were in the process of resetting for the big blast when strong Santa Ana winds came up and blew the whole thing over. There was nothing we could do to save it because the model had already been wired with primacord, and John wouldn’t let anybody in there.” Having failed to get the final explosion, the team was left with no choice but to rebuild from scratch – an endeavor that took another six weeks.

When audiences at test screenings of the film expressed confusion over whether or not the beast had been killed in the blast, a scene was added to graphically depict its demise and erase any doubts. Using animated fractal shaders, Eugene Jeong rendered a blistering texture on the giant head for a shot of it enveloped in flames moments before the detonation. Subsequent views of the creature being blown to bits featured flying chunks of CG gore combined with practical elements of fire and exploding guts.

Deep Rising concludes with a tongue-in-cheek reveal of a mysterious island, where Trillian, Finnegan and Pantucci – sole survivors of the encounter – wash ashore following the destruction of the Argonautica. The shot – one of the handful assigned to ILM – incorporated a 3-D digital matte painting designed and executed by veteran matte painter Yusei Uesugi and match-moved to a helicopter shot of Malibu Beach with the actors in the foreground. “We had to paint out all of Malibu and paint in this incredible vista,” stated Berton, “which was sort of a cross between *King Kong*’s habitat and a South Pacific island. We used every trick in the book to get our match-move to work. Once we nailed that, we were able to take Yusei’s painting, plop it down on top of the beach and have everything lock together in this big 3-D pullback that slowly reveals the entire setting.”

Despite generally good reviews, *Deep Rising* failed to find an audience and disappeared quickly from theaters. Though disappointed, Mike Shea remained philosophical about the vagaries of filmmaking. “The problem with this business is that a lot of times you do things and become an expert. Then you’re never asked to do them again. I doubt there will be a sequel to this movie, and probably nobody is going to want another squishy octopus. But I am proud of *Deep Rising* and what we accomplished. I believe we created something that was truly unique and that holds its own with most of what’s been done. Those were my goals, and we met them.”

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SPHERE

SPHERICAL MAGIC

ARTICLE BY SCOTT ESSMAN

For thirty years, the boundless imagination of Michael Crichton has provided source material for some of cinema's most popular fare, from *The Andromeda Strain* to *Jurassic Park*. Now, another of his speculative tales has found its way to the screen with the Warner Brothers release of *Sphere*, helmed by Academy Award-winning director Barry Levinson. In the movie version, written by Stephen Hauser and Paul Attanasio, a team of scientists is recruited by the government to investigate what appears to be an enormous spacecraft, resting at the bottom of the Pacific Ocean, untouched for three hundred years. In a sophisticated deep-sea habitat, the team sets up a home base for examining the vessel and its mysterious cargo – an immense, sphere-shaped object. However, when contact with the surface is abruptly terminated during a cyclone, terrifying things begin to happen in the claustrophobic confines of the lab.

With nearly the entire narrative taking place underwater, a team led by executive producer Peter Giuliano scoured the *San Francisco* area in search of a facility that could handle the mammoth sets the film would require. After rejecting a handful of former military bases, they settled on Mare Island, a 5000-acre deserted naval shipyard with a colossal drydock surrounded by warehouses and shipbuilding hangars. With renowned production designer Norman Reynolds on board, a plan was hatched to construct the entire underwater environment to scale in the flooded drydock, with adjunct buildings serving as soundstages for spaceship and habitat interiors.

Later, when it became evident that the drydock would be impossible to light, the entire project was shut down for reevaluation. Giuliano enlisted the aid of visual effects supervisor Jeffrey A. Okun, and a new plan was devised. Rather than build the underwater setting intact, individual sections would be constructed in five separate tanks erected by the production inside an enormous hangar. Okun would be responsible for tying everything together via visual effects, including the use of miniatures to expand the scope of live-action sets. Okun broke down every shot in the film in terms of effects components, and, with a 430-shot storyboard in hand, proceeded to canvass the effects community.

One company already onboard was Steve Johnson's XFX. Hired before the shutdown, the XFX crew was well on its way to delivering finished work on a variety of prosthetic and animatronic effects. Over the next few months, before the start of five months of principal photography, Okun and visual effects producer Thomas M. Boland would recruit several other companies to the effects team. Chief among them was Cinesite Digital Studios, Hollywood, commissioned to handle the bulk of the CGI and compositing work. The Cinesite crew, guided by visual effects supervisor Carlos Arguello, had so impressed Okun with an animation test they pulled together for the show that he abandoned his plan to parcel out the digital work to more than one facility. Also recruited was Grant McCune Design, tasked with building and shooting miniatures that would be used to extend the live-action sets, as well as creating establishing shots for the entire underwater habitat.

Completing the slate was Sony Pictures Imageworks, hired late in the show to execute a revamped end sequence.

Upon touring the Mare Island sets in preparation for the model build, Okun, GMD supervisor Grant McCune, chief modelmaker Montgomery Shook and designer Clark Schaffer concluded that miniatures would have to be built in two scales – one-sixth and one-sixteenth – for wide-angle and closeup views. Modelmakers began with a small-scale tabletop study of the full underwater environment. Then, on half of their 5000-square-foot stage at GMD, they erected a master forty-by-twenty-foot sixteenth-scale set of the entire area that included the dome-shaped habitat, the submarine hangar dome and a coral tunnel connecting the habitat to the spaceship – all dwarfed by the towering craft embedded and partially concealed by coral in a nearby crater. “We built a sixteen-foot-tall tail fin,” said Shook, “a three-quarter view of its side and the engine exhaust port manifold as a forced perspective model, since it was so large. Even as a miniature, if we had built the entire set to scale, it would have spilled out of our facility.”

As it was, GMD needed to secure the use of an additional 6800-square-foot stage at Motion Control Rental Services, located directly across the street. Co-owned and operated by David Stump, who had been engaged as miniatures director of photography on the film, MCRS would house all of the sixth-scale miniatures, including the habitat, ocean floor, submarine dome hangar and two submarines – one for the descent and another for the ascent.

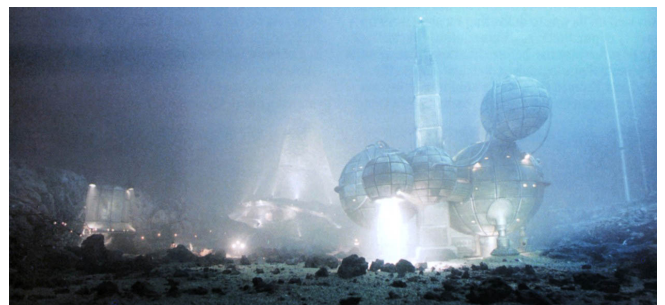
A plywood understructure delineated the essential shape of the coral-covered ocean floor, including valleys and caverns, and the crater where the spaceship was situated. “Where the coral had to match set pieces,” said Schaffer, “we carved four-pound urethane rigid foam. To cover areas that did not have to match anything, we took styrene foam and roughly carved it with hand tools. Using little squirt bottles, we evenly sprinkled acetone onto the surface of the foam to create small pits, which approximated the look of coral. We finished the coral by painting the foam with acrylic browns and blues, and a bit of purple and black.”



Digital artists at Cinesite created the mysterious object found in a crashed spacecraft at the bottom of the ocean in the Barry Levinson film Sphere.



Concept art for a Cinesite scene in which a fleet of digital ships was created around only two real vessels.



A deep-sea habitat – built and shot at Grant McCune Design – overlooks the spacecraft’s immense tail fin in a scene shot dry for wet.

Under the supervision of Monty Shook, a crew of ten fabricated the detailed multiple domes comprising both the sixth- and sixteenth-scale habitats. “The basic structures were created from acrylic hemisphere patterns,” stated Shook, “backed with foam and covered with heated styrene. They were trimmed into eight geometric pie configurations and cemented together to make segmented hemispheres.” Using acrylics, modelmakers painted the habitat iron black, highlighted with an aluminum powder finish. Miniature crawl tubes joined the various areas of the habitat, and several hundred aircraft instrument lights, placed around the set, lit the way between the habitat and the ship.

The spaceship fin was fashioned as a plywood form covered with Sentra, a polyvinyl-chloride material, and coated with a catalyzed polyester to add integrity, seal the plywood and glue the seams. A multilayered metallic lacquer finish and a patina of green-colored oxides were applied over the sealant to create the look of titanium paneling. The ship’s exhaust manifold and rocket engines were fashioned out of molded urethane. Also built were the two submarines. “The submarines had to be durable, yet lightweight to accommodate motion control motors and lighting systems,” said Shook, “and easy to dismantle so that we could access the interior mechanics. We fabricated them from thin polyester, with fiberglass sheeting.”

As *Sphere* opens, psychologist Norman Goodman (Dustin Hoffman), arrives via helicopter – shot entirely greenscreen on an indoor stage at Mare Island – on the deck of a Navy ship, one of a fleet gathered at the site of the downed spacecraft. With only two real ships filmed on location in Hawaii, Cinesite was asked to supply additional vessels for the sequence, achieved via digital matte paintings by Charles Darby. “We color-corrected the clouds,” said Arguello, “and added a ring of floating buoys with animated lights indicating where the spaceship rested on the ocean floor below.”

Onboard the ship, Goodman is united with the rest of the team selected to investigate the unidentified spacecraft, including biochemist Beth Halperin (Sharon Stone), mathematician Harry Adams (Samuel L. Jackson) and astrophysicist Ted Fielding (Liev Schreiber). Interiors of the ship were shot on the U.S.S. Jeremiah O’Brien, a restored *World War II* vessel. Following a debriefing by expedition leader Barnes (Peter Coyote), the group is transported via descent sub to the deep-sea compound, 1000 feet below sea level.

The descent would be the first of many scenes blending motion control elements of the model submarines – filmed by Dave Stump and camera operator/programmer Tom Shaughnessy – with both scales of miniatures sets. In preparation for shooting the dry-for-wet environments, director of photography Greg McMurry and special effects coordinator Richard Helmer custom-designed and installed identical infrared smoke distribution systems on both shooting stages. “The infrared sensing systems allowed for continual smoke density monitoring,” Okun elaborated. “They fed the monitoring information to a computer, which adjusted the flow from the smoke generators to maintain an absolutely constant density – very important when just a single motion control pass lasts eight hours or more.”

On the motion control stage, Stump first shot a greenscreen matte pass of the sixth-scale sub model, then additional passes in smoke for glows from its headlights, interior lights, running lights and beauty lighting. A shot of the sub arriving at the habitat docking port – dubbed the moon pool

by the model crew – was executed practically. “Our engineer, Bill Shourt, created a tail-mounted rig on the sub model that connected it to a pan/tilt head on our motion control boom armature,” explained Stump. “The tracks were fifteen feet behind the sub off of the armature. The camera was on one boom and the sub was on another, which allowed us to pan, tilt and roll the sub as it moved, in addition to booming, swinging and tracking it in. I shot another pass – without the sub – to split the armatures out of the shot.”

Cinesite sweetened the shots with several digital enhancements. “When the sub was still near the surface,” said Okun, “they added shafts of light in the form of interactive spectral highlights that come through the water from above.” 3-D bubbles and smoke for a cavitation effect were also added using Dynamation and RenderMan, while additional diffusion on the sub lights to create underwater ambiance, when needed, was rendered in Alias and Softimage. All of the elements from the submarine shots were composited by Cinesite on the Cineon, and the motion control rigs digitally removed.

After settling into the habitat, the scientific team is outfitted in custom dive suits for a venture across the ocean floor and into the spaceship. A still photographic image of the sixteenth-scale set would be employed as a set extension for a shot of the characters leaving the habitat “Every time the actors exited the habitat in footage shot in the tanks at Mare Island,” explained Okun, “they were surrounded only by the moon pool ring above, plus one foot of the exterior habitat set So we had to add set extensions to every tank shot – fifty in all for the entire film. Twenty-five to thirty percent of the shots in the movie have still-frame set extensions, photographed with a Nikon 35mm camera, with dimensional moves. While we were shooting the stills, Adam Greenberg, the main unit DP, would give us specific lighting recommendations so that our stuff would match his perfectly. Compositing was relatively simple, since Cinesite could easily track and move around the still frames.”

In the initial reveal of the spaceship fin, the composited still photo was enhanced by a Cinesite matte painting which extended the lights ringing the ship and provided a horizon line. When Barry Levinson later decided that he wanted to see more decaying metal on the ship, Charles Darby added rusticles to the photo. For ensuing shots of the team in the underwater environment, Stump also shot still photos of the sixth-scale, smoke-filled miniature set, photographing it from every direction to match the angle, perspective and focal length of the live-action plate photography.



Chief modelmaker Monty Shook adds detail to one of the habitat domes.

Trekking across the ocean floor, the research team enter a coral tunnel leading to the spaceship. Rather than reconfigure an underwater set in one of the Mare Island tanks, which would have been costly, Okun was approached to execute the shot as an effect “We found a shot of the actors walking underwater in the tank,” said Okun. “Then we took a still photograph of a maquette that Norman had built to show Barry how he was going to construct the coral tunnel, and we inserted the actors into it That simple shot saved the production about \$2 million.”



Miniature set designer Clark Schaffer attends to the habitat on stage.



Swarms of jellyfish – puppets built by Steve Johnson's XFX and digital replicas created by Cinesite – attack one of the scientific team.

Once inside the spacecraft and through the airlock, Goodman and Halperin enter an elevator – generated as a 3-D CG virtual set by Cinesite – that takes them up to the flight deck. There, they discover a holographic control panel, which Halperin uses to trigger the flight data recorder, a virtual reality playback that reveals the ship to be an earth vessel returned through time from some distant future. For the elaborate sequence, designed and storyboarded by Okun, Cinesite fashioned a 3-D hologram in Alias and Dynamation depicting the vessel's passage through the solar system, a nebula and into a black hole.

Using reference photographs from the Hubble telescope – provided by Jeff Okun, courtesy of Jet Propulsion Laboratory – Cinesite first created wireframes of the elements in the hologram. “We pulled mattes and rotoscoped the actors, shot live-action on a flight deck greenscreen set, in order to place the holographic elements behind them,” explained Arguello. “That was difficult, since there was smoke moving through the set, which we had to match.” A volumetric render, developed by Jerry Tessendorf and technical director Gokhan Kisacikoglu, was used to create the nebula and black hole, with stars in the nebula designed in Alias. “During filming of the nebula sequence, Jeff had moved lights through the live-action set for us to add little 3-D stars that would appear to interact with the actors, creating reflections on their face plates.”

To depict the black hole and the image of thousands of stars being sucked into it, digital artists relied on a bit of artistic license. “In reality,” stated Arguello, “it would have been a completely black void; but since we needed to see it, we rationalized that we were seeing the light about to be sucked in, and made it a yellowish-white swirl.” At the end of the black hole sequence, Okun wanted a dimensional starfield to open up and swallow the ship. Cinesite complied by implementing a version of a particle systems gag developed by Richard ‘Doc’ Baily – an effect in which stars begin streaking and an implied horizon opens up, engulfing the viewer in a 3-D visual storm. Barry Levinson liked the element so much, he would insist on reusing it for the last shot in the film.

In the ship's cargo bay, designed by Norman Reynolds and realized as a fully virtual set by Cinesite, the team confronts the enormous sphere. “One of the advantages – and disadvantages – of having a virtual set is that you can keep changing it,” remarked Arguello. “At first, all the structures in the background were designed very large, so as to dwarf the actors. But then the room looked too cramped. So, at Jeff's request, we kept reducing the size of the structures to create more space – which ended up making the whole environment look bigger.” To integrate greenscreen footage of the actors with the virtual set, digital artists had to recreate light beams and lens flares from the



XFX artist Mark Killingsworth paints a sea snake.

characters' flashlights and headlights. "A special code was written in our R&D department that simulated the way a flashlight behaved in relation to the camera. When the beams were directed away from camera, they appeared stronger, and when they were directed toward camera, they softened. Each of the flashlights was a different element that had to be separately rotoscoped and tracked."

Although Levinson had originally envisioned the sphere as a giant chrome ball, its design would continue to evolve over many months. "The solid chrome ball idea just wasn't working," noted Okun. "It was not visually exciting, and it wasn't popping from the scene. It looked like it was part of the background environment and didn't seem foreign enough to the spaceship – which was a problem, since Barry wanted it to be obvious that the sphere was not a part of the ship, but something that the spaceship was carrying." Finally, Okun suggested changing the inert chrome surface to one with organic activity and color. Working with the digital team at Cinesite, he proceeded along those lines, ultimately settling on a textured design, devised by animator Tim Ketzner. Levinson then suggested a champagne gold color, similar to that of NASA's lunar lander.

As Adams draws near to the towering sphere, he is seduced by its inexorable attraction and drawn into it – an event conveyed through a shot in which his reflection suddenly appears on the surface of the sphere, as if magically emerging out of mercury. "The reflection slides up, over and behind the ball," explained Okun, "and when we look back to where he's been standing, he's gone." The sliding reflection on the sphere would be one of the last effects to be rendered by Cinesite. "When the sphere was still a chrome ball, the reflection had been done as a carnival mirror, which was unbecoming to the actors. So once the idea of a new sphere design was adopted, Craig Mathieson devised it as a textured reflection. For a scene showing Goodman entering the sphere, we didn't have a single shot of Dustin to use. So motion tracker Cristin Pescosolido took Dustin's head and put it onto Sharon Stone's body, using the natural contours of the dive suit for blend lines."

Emerging from the sphere in an unconscious state, Adams is carried back to the habitat, where strange things begin to happen. One of the government crew, Fletcher (Queen Latifah), ventures outside the habitat to attend to a maintenance chore and encounters a seemingly harmless school of exotic jellyfish that quickly turns deadly. The attack sequence that follows was accomplished employing a combination of puppet jellyfish filmed on the live-action set, real ones photographed in a blue tank at Monterey Bay Aquarium and digital replicas manufactured by Cinesite.

For shots of the actress touching the jellyfish, XFX technicians Lennie MacDonald and Bill Bryan designed and fabricated puppeted versions using, as reference, videotapes of real jellyfish from the Monterey Bay Aquarium. Tentacles on the puppets were made of silicone, while plastic bag technology – which XFX had perfected for creature effects in *Species* and *Lord of Illusions* – was used to create realistic bell movements. "We forced the plastic bags full of air, like a balloon, to form a very thin fragile membrane," related Steve Johnson. "Mechanisms placed inside the bags caused the bells to constrict upon activation, shooting water out and forcing them forward exactly the way a real jellyfish moves." Chris Nelson and Bob Newton puppeteered the constructs on set, five at a time, leading them with monofilament wires so that they hit their marks precisely.

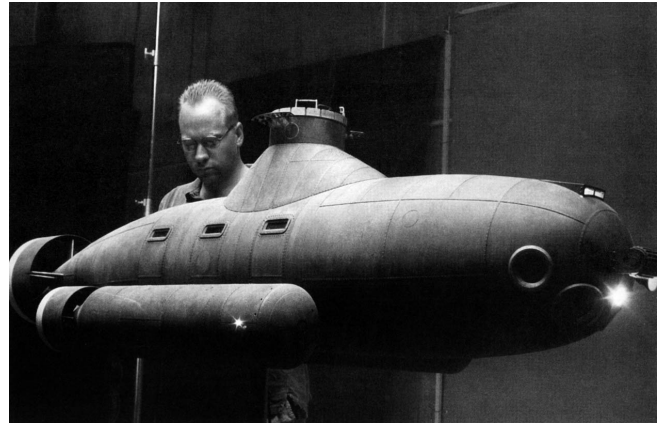
In instances where the jellyfish had to move in specific ways, CG substitutes were employed to augment the live-action plates. "We used the Monterey Bay jellyfish as a reference and created our

own texture and motion,” remarked Arguello. “We created wire-frames for the CG jellyfish, the real ones, and Latifah to track their motion, since they all needed to move at the same rate.” Cinesite also added interactive lighting, including an artificial radial highlight for dramatic effect.

When compositing supervisors Marcel Martinez and Patrick Tubach subsequently determined that the puppet jellyfish and CG jellyfish were not blending smoothly, they digitally enhanced the bells of some of the puppets and, at Jeff Okun’s direction, added interactive lights and shadows. “Once we started doing that,” Arguello observed, “we ended up replacing the bells that required the most enhanced movement. Jeff Lin, Aimee Campbell, John Wallace and Robert Bardy – our chief jellyfish animators – gave the fully-CG jellyfish increased activity around Latifah to contrast the unidirectional movement of the puppeted ones.”

As the jellyfish penetrate Fletcher’s helmet, a chilling death scene ensues. “It would have been too dangerous to have the actress’ helmet fill with water,” Johnson elaborated, “so we created a cable- and air-activated mechanical head with silicone skin and a fiberglass underskull. It was rigged for the mouth to open, head to move around and eyes to squint. We gradually filled the helmet with water and put air tubes into the mouth and nose to blow bubbles once the helmet filled. With air mortars, we introduced jellyfish tentacles from the opaque sides of the helmet. The inside of the helmet became a churning mass of air and blood to simulate the jellyfish stinging her face.” A dummy corpse was used for a follow-up scene in which Halperin pulls jellyfish tentacles out of Fletcher’s mouth and nose.

More misfortune befalls the team as Jane Edmunds (Marga Gomez) is discovered banging lifelessly along the upper exterior of the habitat. For the underwater scene, XFX effects supervisor Joe Colwell fashioned a waterlogged dummy. “In tests, we had mistakenly created a silicone that looked like skin which has pruned from overlong exposure to water,” recalled Johnson. “We could never have sculpted that in a million years.” To retrieve the body, Stone reaches for Edmunds’ leg, pulling off a shoe and grabbing her saturated foot. “The foot was rigged with a skeleton and thin silicone skin. We injected it with a material called Ultra Ice that we tinted blood red, then formed back into a foot shape. We slit the skin so when Stone grabbed it, the foot squished to the skeleton.”



The transport submarine that descends to the wreck site is readied on stage by Clark Schaffer.

For a sequence in which Goodman is attacked by a sea snake, the XFX team fabricated a puppet snake out of translucent plasticized silicone, flexible enough to allow its jaw to open very wide and transparent so that its internal skeleton was visible. Several snakes were built, including a hero version, with cable-operated head functions, puppeteered from above by Chris Nelson via a single rod attached to the top of its head. For a POV of the snake coming straight at camera, an oversize version, built five times larger than life, was puppeteered from behind. Among its many functions were a flexible tongue and eyes that had a nictitating membrane, mechanized by Todd Minobe.

Back in the habitat, Goodman is once again terrorized – this time by a hagfish that wriggles up his pant leg. XFX sculptor Greg Smith designed the silicone creature with receptacles on its underside that attached to a rigid piece of track. Also fabricated were 3000 seven-inch-long giant squid eggs for a scene in which Goodman and Halperin are showered by eggs from an unseen monster. To produce the enormous quantity, lab technician Nate Hayden injected 125 gallons of hot-melt vinyl into successive banks of molds. Giant squid embryos – injected into the centers of 1500 of the eggs – were manufactured out of an epoxy resin unaffected by the heat of the hot-melt.

As the mayhem escalates, crew members are eliminated one by one until only Halperin, Adams and Goodman remain. Paranoia runs rampant as each entertains the idea that contact with the alien sphere is somehow responsible for the terrifying manifestations that are killing the crew. In a desperate move, Halperin rigs bombs to destroy the underwater habitat. The ensuing chain reaction of blasts – building to a mushrooming explosion akin to a hydrogen blast – was accomplished with a blend of practical and digital pyrotechnics.

Practical explosions for the scene were filmed in a large steel tank with four inch-thick plexiglass viewing ports on its side, designed and constructed by Helmer and McMurry in the GMD parking lot. “We put a camera mount on scaffolding that extended across the top of the tank,” stated McMurry, “so we could set off the explosions and photograph them from various angles, including straight down into the water and straight across. To film from the scaffolding without drenching the camera, we pressed a four-foot-wide hollow plexiglass sphere – recycled from the full-scale practical escape sub – halfway into the surface of the water and placed the camera at its center. That way, the camera could face down without getting wet or having to shoot through the water’s surface.” McMurry shot the explosions with a Photosonics camera, at 300 to 360 frames per second. Air mortar explosions – conducted underwater in a larger round tank – were also captured on film, as were several dry explosions, set off at a rock quarry in Lake View Terrace, north of Los Angeles. “We put the Photosonics camera, with a large blast shield, on a crane eighty feet in the air, looking straight down. Then Richie Helmer rigged some very interesting chemical and gasoline explosions that would flare up towards the lens.”

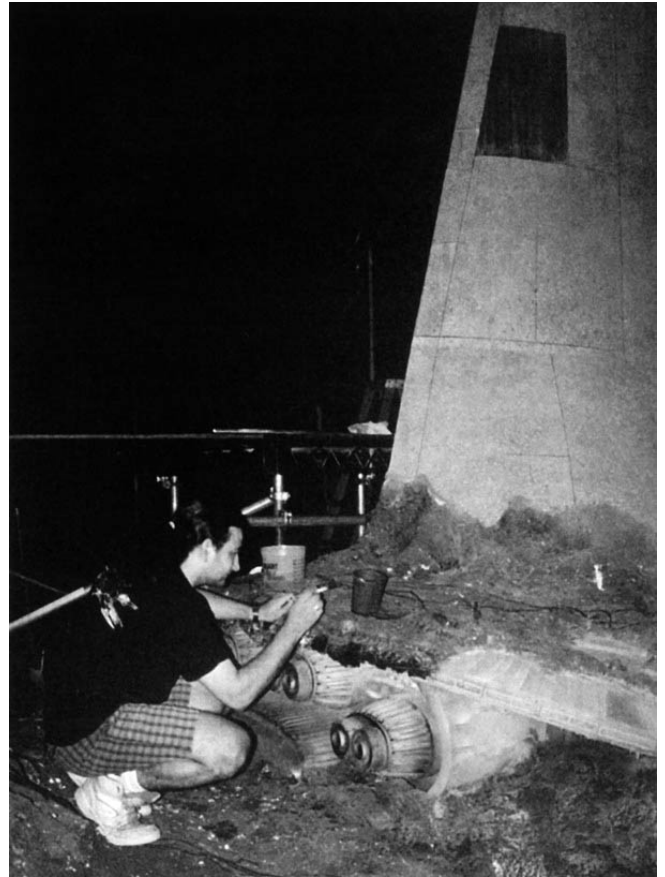
Destruction of the habitat domes was the main challenge. “Jeff wanted to indicate the sudden loss of pressure as they were hit by the explosion,” said Monty Shook, “but having made the domes out of a urethane-based core with a plastic coating, they looked like a rigid material with a rubber liner when we imploded them.” With input from Bill Shourt, GMD fashioned, instead, a gypsum composite that acted as a fragmentary shell, lined with urethane. “First, we imploded the domes with a vacuum-collapse cylinder system; then we enhanced that with a reverse-angle shot, using an air mortar to force debris out from within the dome.”

As the fireworks commence, the survivors flee aboard a mini escape submarine. Shots of the craft leaving its hangar featured motion control greenscreen footage of the sixth-scale sub model composited against a still photo background plate of the entire sixteenth-scale set, shot by Stump and Shaughnessy. Submarine interiors were fashioned by Clark Schaffer, Tom Rush and Rick Won at GMD, complete with miniature costumed figures and props. The exterior, supervised by Jack Edjourian, utilized seamless Pyrex spheres, built by Sci Tech, to represent the sub's front windows.

Bombs exploding at the entrance to the coral tunnel precipitate the total disintegration of the underwater environment. Cinesite composited the various practical elements and enhanced the shots with CG elements. "We mapped a still photograph of the sixteenth-scale miniature spaceship," said Arguello, "and rebuilt the jet engines and a 3-D fin so that we were blowing up a CG ship." Sequence supervisor Mark Michaels, created a wire-frame of the tail fin so that digital artists could simulate its panels separating and flying apart. "For the scene where the habitat implodes, we composited practical shots of the domes imploding with a CG habitat tower disintegrating, as panels from its center shaft are blown away."

The mushrooming blast and subsequent shockwave – created at Cinesite – roll across the ocean floor, chasing the escape sub. Just when it seems unlikely that the survivors will avoid the wrath of the oncoming wave of destruction, the action cuts to the ocean surface where the escape sub is seen breaking the surface. The shot – originally slated for principal photography – would again fall to the effects team, with GMD commissioned to build a third-scale model that could believably interact with water. Hastily, the GMD team set about building the sub – a duplicate of the live-action escape sub shot during production.

The scene was filmed at Falls Lake, a permanent outdoor tank on the backlot at Universal Studios. Painted plywood shapes of the background ships visible in the shot – designed to match the original matte paintings – were placed on C-stands in the tank, and the escape sub model was affixed to a rig so that it could be made to break the surface of the water from below. Using two cameras at surface level, underwater cameraman Pete Romano filmed the action repeatedly; but the rig never executed the move with the requisite force. Finally, at Okun's suggestion, the proper outward momentum was attained by holding the sub model from below and using two attached handles to shove it up through the surface.



Modelmaker Jack Edjourian paints coral growth encrusted on the tail fin of the giant spacecraft.

Late in postproduction, Barry Levinson would devise a more spectacular scenario for the movie finale. In the new ending, the sphere, from its position on the ocean floor, would speed toward the camera and blast through the ocean surface, then ascend into the atmosphere and into space, streak away and finally disappear. Okun – still filming at Falls Lake and rapidly running out of time – would employ an effective, but decidedly low-tech means to capture the necessary practical elements for the shot. “We got a four-foot-diameter toy chest, hooked it to a crane and yanked it out of the water, solely for the splash element. We knew that we would have to matte in a CG sphere later.”

With Cinesite rushed to complete its own work, the production turned to Sony Pictures Imageworks for the added sphere departure shots. CG supervisor Walt Hyneman had just weeks in which to deliver the shots – a task that included reconstructing the sphere itself. “Cinesite had rendered their static sphere in *Alias*,” stated Hyneman, “but now the sphere was required to move, which meant introducing motion blur.”

Using shared data files from Cinesite, Serge Sretschinsky wrote a RenderMan shader based on the relationship of the original curves and, with Jay Redd, created a color and lighting scheme to emulate Cinesite’s sphere. Seven stills – each shot at a different distance from a vertically oriented ocean floor miniature, built by GMD – were incorporated into a nested zoom to simulate the traveling image. Laurence Treweek wrote a shader to cross-dissolve among the stills as the shot went deeper and deeper into the sea, while Todd Pilger created particulate matter to replicate silt swept off the ocean floor along with the sphere. A distortion map was used to create ripples in the water as the sphere bolted up. Treweek also rendered caustic passes, light patterns made by the surface of the water on the ocean bottom and on the sphere itself. “We had to light the shot well enough to see the sphere, but still keep the shot dark to make it look like deep water,” Hyneman remarked. “Bart Giovannetti composited the shot and devised a technique where the edges of the frame were distorted to help sell the idea of the shot being underwater.”

As the sphere breaks the surface, SPI matted its CG element into the shot, then composited it passing through two live-action plates of waiting ships. A shot of the sphere shooting directly up towards a bank of clouds was done as a series of matte paintings by John McGee, with subsequent views of its entering a cloud tunnel done using footage Okun shot specifically for the sequence. “We took a hand-held fogger,” recalled Okun, “fed compressed air into it and blasted it at a camera lens. We shot it a variety of ways – with different speeds and levels of air compression, and using fans to change the shape of the clouds. The effect was similar to looking into the back end of a jet and watching the plume discharge.” Sony selected specific takes and reversed them so that it looked as though the camera were going into the clouds. A particle systems effect, created by Mark Hall and rendered in Birps – SPI’s front end to RenderMan – was used to mimic the condensation that built up around the sphere as it traveled through the sky. The final shot in the sequence – of the alien object streaking away into a starfield – was a reuse of Cinesite’s collapsing black hole, seen earlier in the film.

Representing as it did a fusion of innovative and time-honored effects techniques, *Sphere* once again proved that whether it be the far reaches of space or the deepest ocean abyss, few boundaries exist in modern filmmaking that cannot be overcome. “In this film,” concluded Jeff Okun, “the visual effects were nothing more than a means of augmenting the reality of the deep-sea environment. Ultimately, *Sphere* is a human story with science fiction elements, as opposed to a science fiction story with human elements.”

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Visual effects supervisor Jeff Okun examines a scale replica of the escape submarine.

DARK CITY MASTERS OF THE DARK

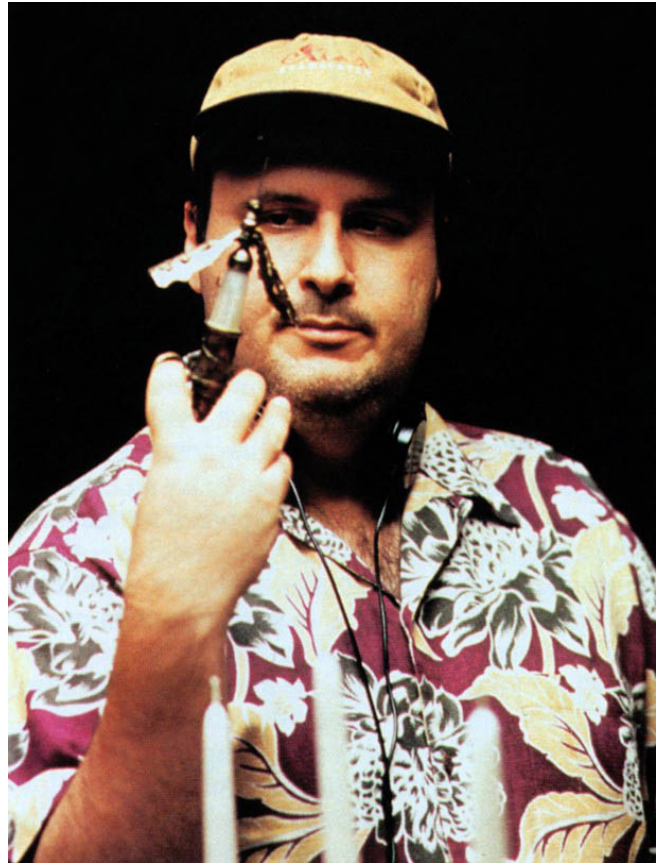
ARTICLE BY E.TELLE SHAY

“First there was darkness. Then came the Strangers.” So begins the eerie narrative for *Dark City*, the latest project by Australian writer-director Alex Proyas, whose stylish 1994 feature, *The Crow*, first showcased his innovative talents. In actuality, the idea for *Dark City* – a paranoid tale of mind control in an alternate universe manufactured and manipulated by aliens – predated *The Crow*, having been conceived nearly a decade ago. At the time, Proyas had pictured a far simpler scenario, thinking he would somehow find a way to get the picture made in Australia on a shoestring budget. In the interim, however, his career would gather momentum, and the little movie he had envisioned would gain the backing of a Hollywood studio to become one of the most ambitious films to emerge from Australia’s burgeoning industry.

Like the project’s scope, the story for *Dark City* would also metamorphose over time, originating not as science fiction but as a contemporary tale with surreal, dreamlike elements. “It started off as a story about a hard-boiled detective in this sort of noirish environment,” Proyas recalled, “who is working on a case where nothing makes sense. He is a man of logic, and he slowly starts to go mad as he uncovers this big existential mystery. At some point, though, I realized I was writing a science fiction movie, and it just evolved into that.” Refining the complex characters and narrative with the help of screenwriters Lem Dobbs and David S. Goyer, Proyas shifted the focus of his story away from the detective to the plight of protagonist John Murdoch (Rufus Sewell), who, in the film’s opening, awakens to find himself in a strange hotel room with total amnesia and a dead prostitute nearby.

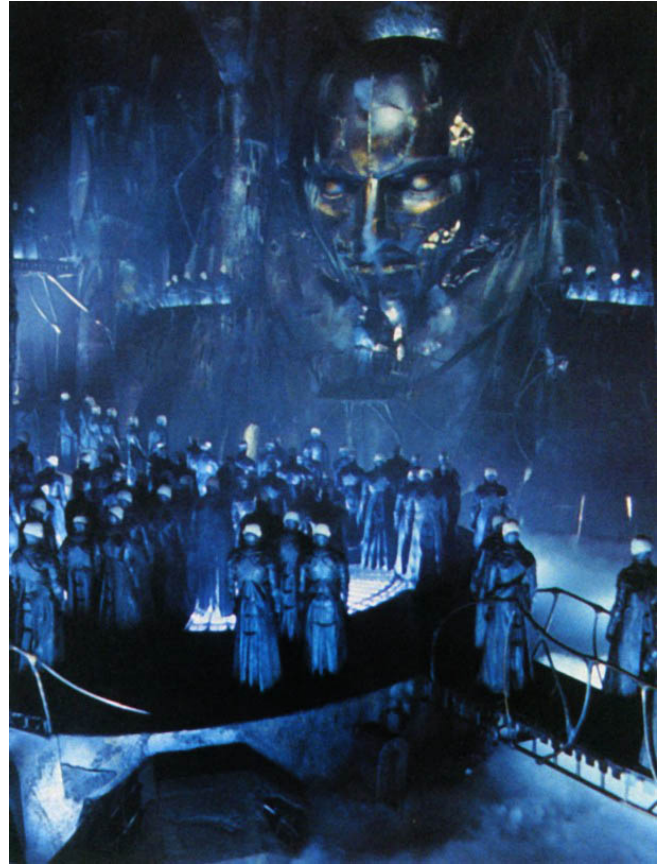
Bewildered, Murdoch escapes into the night in search of clues to his fragmented past, pursued by a band of sinister-looking men, in homburgs and long black cloaks, known as the Strangers. What soon becomes evident is that these Strangers, no ordinary men, dwell in a chamber beneath the city and collectively possess the ability to alter physical reality through a process called ‘tuning.’ Periodically inducing a state of mass unconsciousness in the inhabitants above ground, they stop time, reshape the city and its architecture and, with the help of a slightly mad scientist, Dr. Daniel Schreber (Kiefer Sutherland), inject new memories into its sleeping citizens. Somehow immune to their machinations, and endowed with tuning powers of his own, Murdoch eventually confronts a chilling reality – that the city is nothing more than an experiment, a satellite in space manufactured by a dying race of aliens so that they might observe human behavior and unlock the secrets of the soul.

Joining Proyas in an effort to get *Dark City* off the ground was fellow Australian Andrew Mason, whose association with the director – spanning some eight or nine years – included a stint as visual effects supervisor and second unit director on *The Crow*. Having headed his own commercial production company and founded Australia’s first visual effects studio during the course of a twenty-year career, Mason was no stranger to effects – an asset that would prove invaluable in the current undertaking.



Writer-director Alex Proyas on the set of his noir futuristic thriller, *Dark City*.

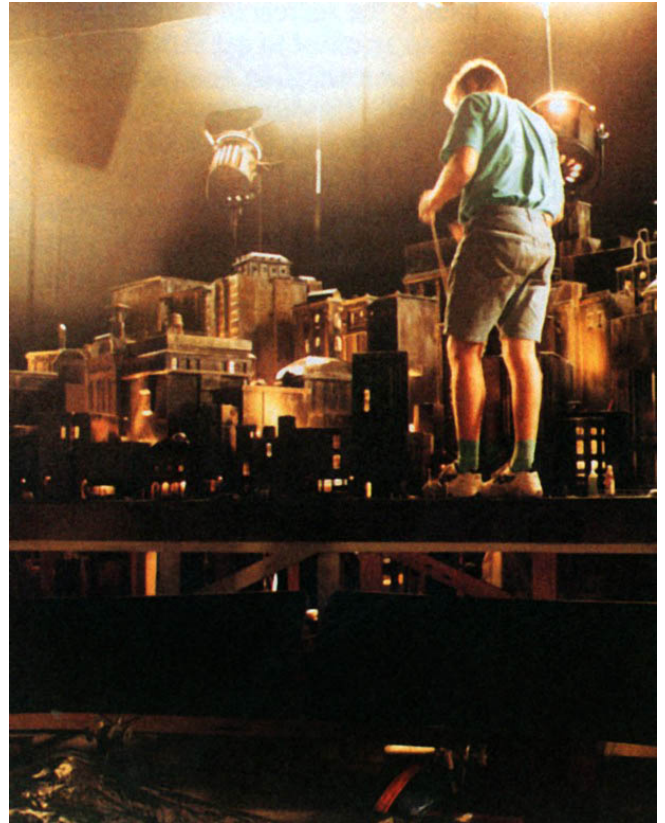
After the project fell out of development at Touchstone Pictures, then Twentieth Century Fox, a deal was finally cemented in early 1996 between New Line Cinema and Mystery Clock Cinema, the production company that Proyas and Mason had founded together. Without further delay, the filmmakers quickly launched into six months of intensive preproduction, with Mason wearing two hats, as both producer and visual effects supervisor. Both he and Proyas, constrained by a budget considered small by Hollywood standards, were determined to keep the effects work in Australia. "It was a bit scary," Proyas admitted. "There were moments when we thought, 'This might not work out.' But really, it's a question of management more than anything else. We were confident that we could find the talent. These days, it doesn't matter where in the world you are – if you can get the right people, that's the most important thing. After that it's just a matter of organizing the work effectively."



Unknown to the denizens above, alien Strangers manipulate all aspects of human life from an underworld haunt.

One of the first to be recruited to the international creative team was Mara Bryan, a native New Zealander who had been working as an effects producer in the United Kingdom for years. Although she would later step in as visual effects supervisor when the demands of producing made it impossible for Mason to handle both roles, Bryan's first order of business was to make the rounds of motion control and postproduction houses in Australia in search of talent that could handle a heavy digital workload. "Everybody was terribly enthusiastic about the project," commented Bryan, "but totally unprepared – in terms of equipment, experience, pretty much in every respect. My first thought was that I would spread the work amongst a lot of postproduction houses. Then, because of economy of scale and budget considerations, it became clear that it would be wiser to place it with one company that was prepared to gear up for the task."

That company was Dfilm Services, a scanning and optical house in Sydney that had just begun to expand into compositing and CGI work. With the help of its creative director, Peter Doyle – whom Bryan had met previously when both were working at Mass.Illusion in the U.S. – Dfilm convinced the filmmakers that it could quickly assemble the necessary equipment and talent to handle the assignment. Doyle – something of a pioneer in the digital arena who, upon leaving Australia in the eighties, had established one of Europe's first digital film facilities in Munich – was a welcome addition to the team. "We started prep work around July 1996," Doyle recalled, "just going through storyboards and getting a feel for the film. It was such a unique project – clearly left of center – we wanted to make sure that the team we were putting together would be a good match. We also wanted to try an experiment, to find out what would happen if we assembled a small team of, say, ten heavyweights – all the really good supervisors around town – and said, 'All right, you're not going to supervise anymore; you're actually going to go back to



With live-action exteriors shot entirely on stage sets, miniatures in varying scales were employed to depict more expansive views of the city.

keyboard work and direct your own shots.' My job would be to maintain an overview and general direction. It meant that we could function as quite a tight little SWAT team, turning out shots quickly and affording Alex the opportunity to provide feedback directly to the person actually doing the work. That approach probably wouldn't work on a big film because the whole infrastructure would fall apart. But it seems to lend itself well to the slightly smaller film – the idea that a director can really get in there and work one-on-one with people.”

While Dfilm geared up, Bryan embarked on a similar search for experienced motion control operators. “Again, there really wasn't a lot of motion control locally in Sydney,” said Bryan. “I flew down to Adelaide to see a company called Digital Arts, which had written its own software and built its own rigs. I hadn't expected to find, in a little place like Adelaide, a company with such sophisticated film knowledge, but these people were just tremendous – a brilliant team that ended up being with us for most of the shoot. They introduced us to a configuration that Alex and our director of photography Dariusz Wolski could operate themselves, recording encoded moves without having to program them first. They just thought that was fantastic, because it gave them such freedom. We ended up using it for the main and second unit shoots, then later brought in a big crane rig that Digital Arts had built for the model work.”

Two other players would be recruited to the effects team during the course of the production. One was Bruce Hunt, who would be called in to direct some second unit, plus all of the miniatures and effects photography arising when the production moved into three separate, additional shooting periods and an extended model shoot. Hunt, whose background was in effects animation and commercial work, would also provide creative input on the digital work at Dfilm and oversee the assembly of effects sequences with the visual effects editors. The other was Arthur Windus, whom Bryan recruited as her replacement when prior commitments made it necessary for her to return to London after the completion of principal photography. In addition to his producing chores, Windus would also fill in as visual effects supervisor, working directly with both Proyas and Hunt.

Some two years earlier, while *Dark City* was still in development, Proyas had sought out the design talents of award-winning creature creator and production designer Patrick Tatopoulos. With a preliminary script in hand, the director had shared his ideas for the film with the artist, eliciting his input. “Alex is extremely visual,” stated Tatopoulos, “and he already had a lot of references and samples of what he was trying to get to. I just went home and drew for about two weeks, then came back with my ideas. We had very similar views, and that was extremely helpful.” Together, Proyas and Tatopoulos would determine many of the basic concepts for the look of the city and the underworld.

Later, Proyas contacted the designer to let him know that the project was stalled and he had gone back to Australia. Disappointed, Tatopoulos kept in touch over the next two years, in the interim re-teaming with Roland Emmerich as the production designer on *Independence Day*. Three months before its completion, he received word that *Dark City* was on again. “After two years, Alex's vision had not changed, and we were still in sync – which was amazing because the script had, by then, been rewritten many times. As soon as ID4 finished, I flew straight to Australia.” There, Tatopoulos joined noted Australian production designer George Lid-die, who had been commissioned to oversee all of the city street sets and interiors. Concentrating exclusively on the underworld, Tatopoulos remained in Australia through conceptualization and the start of construction, then returned to the

States before the actual start of filming to begin work on *Godzilla*. Throughout production, however, he continued to refine existing designs, and on occasion send new ones to Proyas via fax and e-mail.

The settings conceived for *Dark City* would reflect the director's unique artistic vision. "I wanted to return to the simplicity of silent movies," noted Proyas, "or of another era of filmmaking – to get away from these high-tech, elaborately complex images that science fiction films are supposed to have these days. So we went back and looked at things like *Metropolis*, and used that as a launch pad. I was looking for something unique that I had somewhere in my mind. Then it was a matter of coming up with specific images. Patrick is a wonderful draftsman; so he really gives you something very finished. But it was an enormously complicated design process. We knew what we didn't want. That was easy. Trying to find what we did want was the hard part."

For the above-ground city, the look arrived at was that of a vast, foreboding metropolis, characterized by a mix of architectural styles and visual cues owing no particular allegiance to a specific time or place, but with a definite forties film noir sensibility. "Alex wanted the upper world to be something that would feel familiar, although a bit different and strange," observed Tatopoulos. "He wanted to see something that looked surreal and theatrical – like a world unto itself. Because, obviously, at the end of the movie, we realize that this world is fake."

A concept for the underworld was harder to come by. Eventually, Tatopoulos hit upon a look, influenced by the films of German expressionist F.W. Murnau, that combined organic characteristics – narrow, complex passageways like those in a termite nest – with mechanical aspects suggestive of a passé civilization, rotten at its core. "We sort of glommed onto the idea of decay as a guiding concept," commented Tatopoulos. "Once we had that, it all seemed to come together in terms of the storyline. Here was a race of beings that once had at its disposal wonderfully high-tech machinery, technology way beyond anything mankind had ever dreamed of. But that was a thousand years ago. Now the technology is still functioning, but it's seriously in decay. Everything has almost like a metal cancer."

Once detailed designs for both environments were pinned down, the production art department began fabricating full-size sets, where much of the live-action would be shot. "The decision not to shoot anywhere in the real world was based on several factors," explained Mason. "One was that the entire story takes place at night, which meant that either we were on a set where we could control the lighting, or we faced the unpleasant prospect of shooting for seventeen weeks with crews working all through the night. Another deciding factor was that Alex wanted to totally control the design of the Strangers' world; so being on a set was infinitely more practical." Seeking a site large enough to house the gigantic environments, filmmakers found the ideal spot in the Sydney Showgrounds – already selected as the location for a new motion picture production complex – where several unused exhibition halls were pressed into service. One, measuring 350 feet long and 80 feet high, was filled to bursting with a city set. Another housed the equally massive underworld set.

Principal photography began in August 1996. Throughout the four-month-long live-action shoot and several extended sessions to follow, traditional effects would play no small part in the proceedings – a consequence of budget constraints and an admitted fondness on the director's part for the old-

fashioned ways of doing things. “I know a lot about effects,” stated Proyas, “so I’m not shy of them in any way. But I see visual effects in a slightly quirky way – particularly in a film like *Dark City*, where the whole movie is a visual effect. It’s not just specific shots. To me, what’s really exciting is when you can do something on the set using a piece of glass or a reflection or something that creates this wonderful illusion. That’s more exciting, in many ways, than sitting with all of these high-tech computers. In the evolution of this project, the way I had originally conceived of doing the city growing and changing was to create corkscrew buildings – actually build miniatures so that as you spun the model and pushed it up from underneath, it would look like it was growing. So I had a very low-tech approach to how I was going to achieve all of that stuff. But as the parameters of the film changed, I found that computer effects could make it look so much better, and in that context it made sense. In fact, it worked magnificently. But we had to really milk those shots, and we surrounded them with other shots that were achieved in a very low-tech way with simple mechanical effects.”

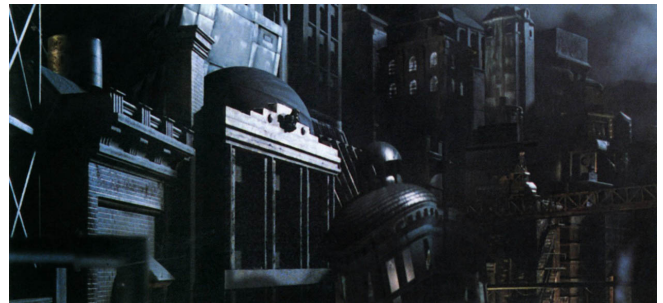
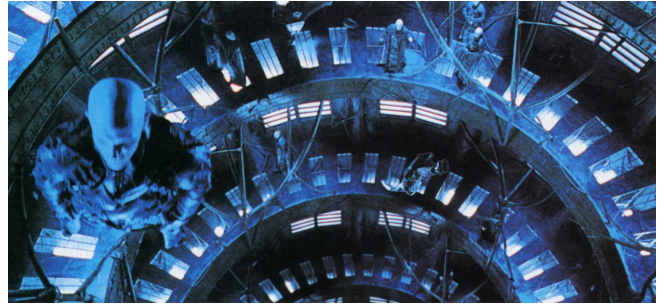
Working in the production’s favor was the fact that the entire narrative unfolds in darkness, which would quickly prove a boon to the miniatures crews, laboring nearby under the guidance of models and miniatures supervisor Tom Davies. “Darkness was our friend,” stated Davies of the ten-month effort that involved, among other things, the construction of literally hundreds of scaled buildings. “Thank God, the city was dark and run down. If it had been daylight, we wouldn’t have been able to do it for the money. Fortunately, we were able to cheat a lot in terms of details.” Assisting Davies was an able crew of six to ten fellow freelancers, many of whom had worked with Mason and Proyas on previous projects. “We were flying by the seat of our pants a lot of the time, but it was great fun. It was a real test for all of us, and my crew did a fantastic job of pulling the rabbit out of the hat.”

To get the most bang for their buck, Proyas and Mason ordered the construction of as many generic-looking structures as possible in the time allotted – models that could be reconfigured as needed. “It was a total mix-and-match approach – which is exactly what we did on *The Crow*,” remarked Mason. “There were only a few scenes where we had to directly integrate the models with full-scale sets, so we just had Tom construct loose buildings in varying sizes and scales, and we endlessly tore them apart and rearranged them for every shot.” In addition, modelmakers fashioned radio-controlled cars and trains, freeway overpasses and a sixth-scale suspension bridge – with dried split peas and lentils doubling as rivets – and an entire interior dining room setting for a sequence in which a quaint cottage transforms into a lavish mansion. Also built were several aspects of the underworld in miniature. One was a tenth-scale model of a deep, cavernous grotto, done in polystyrene foam and fiberglass; another was a 1/50-scale tuning chamber, rendered as a big sphere with gantries and walkways crisscrossing it and wrapping around the inside.

City structures were generally built in scales ranging from 1/20 to 1/500 to force the perspective of the cityscape and make it appear much bigger than it actually was. First to be fashioned was a replica of the main street set, containing some twenty buildings – all done in 1/20-scale and constructed primarily in wood, clad with vacuformed brickwork panels. Brickwork and rooftops on the structures were coated with shellac, then sprinkled with tea leaves to create interesting textures and give the appearance of the buildings being run-down and dilapidated. Crews assembled the buildings in such a way as to easily reconfigure them. “One building might go up

three stories,” explained Davies, “then stairstep, go up another three stories, then have a tower sitting on top of that. By keeping those as separate elements, we could pull that top unit and put on another roof detail to change the look.” Another way of altering the models was through simple changes in dressing. “We built various types of window frames in different scales, and molded them in silicone rubber. We could cast out batches of them to fit any particular building – sort of stock sizes. Then we’d pop out one frame, put a different one in, and with a bit of Final dressing and paint detail, easily change the scale of a piece and place it somewhere else in the model.”

For a sequence of shots in which the entire city is revealed floating in space, Davies and his team spent several months constructing a circular model that measured ten feet in diameter. Nearly five thousand 1/800-scale buildings covered every inch of the rounded top half. “We designed and sculpted about fifty distinct-looking structures,” remarked Davies, “then cast each building out of silicone rubber molds and fast-cast resin. The core of the model, under the road surface, was lit with fluorescent lamps, and most of the surface was masked out with tape and black spray. By leaving areas open, it enabled light to bleed through from underneath; so you had this feeling that the city was actually alive.”



A diversity of digital effects – courtesy of Dfilm Services – was used to produce images of levitating Strangers and morphing buildings.

Although the upper portion was completed early on, the undercarriage – ostensibly the giant mechanism that controlled the city – would remain unfinished for some time. “No one quite knew what it should look like,” noted Davies. “Patrick Tatopoulos and artist Phil Shearer, working with Alex in Sydney, did a lot of concept drawings, and finally came up with a look that everyone was happy with. It consisted of a lot of rootlike structures with spheres that were corroded away – as if you were looking at the outside of the underworld. Light bled down through it from the topside, supplemented by lots of fiber optics.” For filming, the fragile, but exceedingly heavy model was mounted on a ninety-degree tilting rig – like a giant spit – and photographed motion control.

Cityscape miniatures were initially filmed during a four-week period after the completion of principal photography, in a warehouse in Leichhardt, a suburb of Sydney. It was a jerry-rigged setup,” recalled Mara Bryan, who supervised, along with director of miniature photography Michael Wood. “We blacked in one of the sheds and were shooting with smoke and with frame rates of about one or two frames per second, trying to match the same atmosphere that was in the main unit shots. But it was difficult to keep the smoke from moving, because we were in this big, drafty old shed.”

Following a rough-cut screening of the picture for New Line several months later, Proyas and Mason found themselves with an unexpected boon when the studio – in a show of support for what they considered a promising product – allocated additional funding. Cast and crews were called back for

three more weeks of shooting and another seven weeks of second unit and miniature work. At Barcoo Studios, north of Sydney Center, Hunt oversaw all of the additional miniature work, while Davies and his team frantically continued building models next door. Preparations, in particular, were underway for a climactic sequence in which a deadly battle of mindwave energies between Murdoch and lead Stranger, Mr. Book (Ian Richardson), wreaks havoc on the physical world around them. As the tuning process – normally a controlled affair – speeds up during their confrontation, a sphere of pure energy erupts from the underworld, pushing its way up into the city and causing buildings above ground to destruct. “The buildings had to implode because of the sheer force of this thing,” explained Davies, “so we did various tests using plaster, mixing it over flexible foam structures. We ended up using a rigid polyurethane foam, with air cannons on the opposite side of the street to blow the face of those buildings inwards.” Also fashioned for the sequence were assorted movable models on camera tracks and pneumatic rams, spiraling set pieces and a large model of a water tower, filled with water and rigged to explode.

With the original release date moved forward to February 1998, so as not to compete with the *Titanic* juggernaut, five months of postproduction turned into twelve. At Dfilm, the digital workload would expand twice during that period as effects scenes that had originally been dropped for lack of time or money were added back into the film. “Our assignment was twofold,” stated Peter Doyle. “On the one hand, we had to supply all the scanning and recording, making sure that all visual effects shots, whether optical or digital, would fit and cut seamlessly with the rest of the picture. That in itself was quite a challenge, because this film had a very distinctive look and the way Dariusz Wolski shot it really pushed the negative in terms of exposures. To get that happening digitally took lots of time. The second brief was to provide all of the digital effects, which ran the gamut from basic wire removals to classic set extensions, compositing big live-action plates with scaled miniatures, and CGI extensions beyond that.”

Hoping to resolve vital color timing and color management issues before the anticipated rush of effects work, Doyle sought a paradigm that would work. “On The Crow,” recalled Mason, “we had dealt with the difficulties of getting digital negative to match the rest of the photography. Consequently, Peter went through a whole raft of experiments to come up with a way of putting out the same sort of teletiming as our dailies, so that when it was all cut together, it would just look like any other piece of negative. The color timer never knew whether he was timing a digital shot or an ordinary one.”

Advanced testing was also done in preparation for the CGI work. Under computer animation supervisor Sally Goldberg, the CGI team wrote custom code and devised shaders and rendering methodologies that would match the way the models and live-action were being shot. “In the early stages of our work,” noted Doyle, “we tried to keep a very tight theme of development, so that it would be no problem to go through lots of iterations. We spent several weeks, just playing, to see where we could go with various effects.”

Principal among the tests conducted were those involving the tuning effect, which would be given the greatest exposure during the course of the film. “We knew that buildings had to twist around and do strange things,” remarked Mason, “and Alex had drawings of them at various interim stages or in their finished state of transformation. But exactly what the movements would be or how the buildings would look as they were stretching and growing – those kinds of issues – had to be ironed out while sitting at a workstation. It was very much a hands-on exercise for the animators.” Animators began by scanning in cityscapes, which had been shot with buildings purposely omitted. Using Prisms – and some custom code to allow for stretching and a more organic style of manipulation – they modeled the buildings that would be inserted into the shots. “We matched lighting,” related Doyle, “and spent a lot of time getting the renderers and shaders to work. Then we bounced that into Cineon for a final-grade tweak-up and composite before sending it out to film. More than anything, it was a matter of choreography and working out timing issues.”

Other CGI techniques had to be developed for a mindwave effect – seen as a pulsing energy wave manifestation of tuning – and a memory imprinting effect, viewed from the unique perspective of the subject receiving the implant. For the mindwave, what Proyas had envisioned was a rippling, transparent watery effect that exuded sheer power. After numerous iterations to pin down the look, 2-D animation supervisor Jon Thum wrote custom code – a plug-and-play tool that was quick to perform, lent itself to easy alteration and allowed animators to create a pipeline that streamlined the work required to create the effect.

The memory imprinting process was somewhat more difficult to pinpoint. Proyas wanted audiences to experience the imprinting viscerally, with a flurry of images rushing at them and streaming past, as if one were looking up the needle of the syringe. “We tried a few things,” said Doyle, “like kaleidoscopic images that twisted and bent, and different rippling effects that almost looked like an old optical-style time travel thing. Eventually we came up with a hardcore automatic morph that really just pulled the image from a center point, but in a very organic way so that it didn’t just look like a zoom, but like it was really zapping towards you. By



The city, an entity unto itself and afloat in space, is supported by a vast underworld infrastructure, constructed as a motion control miniature.



A psychic battle for the emancipation of humankind was among the digitally enhanced scenes provided by Dfilm.



The first-ever rays of sunlight strike the floating city.

scanning in a much higher resolution, we were able to continue zooming in on the image digitally before the quality fell apart. We timed it so that as soon as we finished the zoom we were on to the next shot.”

“What’s interesting about those sequences is the sheer number of cuts,” Mason related. “There were literally minutes worth of shots – some single-frame, others two or three seconds long – and to scan those in the normal scenario would have been incredibly time-consuming, not to mention difficult just in terms of negative handling. Since Dfilm has an optical department with two Oxberry printers, we generated a classic AB roll with single frame edits onto interpositives, which they then scanned as one complete sequence, marrying everything together using a morph-type effect.”

Water – always a bugaboo in the digital realm – was also required for several concluding shots in which the city, now reconfigured by Murdoch into a world of sunlight and openness, is seen orbiting in space, fully surrounded by water. “There were eight shots in that sequence,” stated Doyle, “and those were the big money shots. One of them was something like 900 frames long.” Animators struggled long and hard to marry CG water to the model. “It was incredibly difficult, as anyone in the industry who has had a go at this sort of thing knows. We spent a lot of time just trying to make sure the thing would render, and figuring out how to do it in a way that would allow us to scale the waves. Interestingly, we didn’t go with Areté, which is the popular water generating software. We found it easier to write our own code, because Areté didn’t lend itself to what we wanted to do. Sally Goldberg wrote the code, and it gave us the control we had to have to match with the miniatures and the motion control.”

Throughout the two years it took to complete *Dark City*, the filmmakers never lost sight of their goal – which was to make the best possible movie within the limits of their resources. “We were jealous of every dollar,” Mason commented. “We’d sit around every couple of days and spend an hour just looking at where our time and money was going. We kept doing minor tradeoffs all the way down the wire – ‘what if we ditched that complicated shot and had two or three smaller ones?’ – that kind of constant shifting.” In many instances such decisions meant accepting less than perfection in one area, so that some other area of production might benefit. “It seems to me that what has happened in the film industry is that visual effects allocation has become an absolutely rigid number. You’re not allowed to take from it. I do understand the necessity of hard-line contractual stuff, because there’s so much at risk, but it’s really sad that you cannot integrate that more into the needs of the production as a whole – which is what we tried desperately to do.”

Having met with critical acclaim for their singular efforts, those involved in bringing *Dark City* to the screen invariably found the experience profoundly enriching. An exercise in sheer ingenuity and perseverance, *Dark City* pushed the envelope of effects filmmaking in Australia like no other movie before it, paving the way for more to follow. “Australia has always been a place to go and shoot films,” concluded Mason. “But with *Dark City*, we proved that you can do all of the postproduction here as well. So it’s bound to grow from here. In May, Twentieth Century Fox opened a spectacular new, modern studio complex, built right in the middle of Sydney on the spot where *Dark City* was filmed. A lot of support facilities are now moving onto that lot, including Animal Logic and Dfilm, editing houses and a whole bunch of physical effects guys and modelmakers. There’s a veritable tsunami of film production about to roll down here.”

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THE SOUND AND THE FURY

image

ARTICLE BY
KEVIN H. MARTIN

It always begins with Tanaka. No matter who tells the tale of Godzilla's origin, the story inevitably centers around Toho producer Tomoyuki Tanaka. Flying home over the Bikini atoll, after a major international co-production had fallen through, Tanaka was seized by the notion of a dormant prehistoric giant being roused by nuclear tests and subsequently cutting a swathe of destruction across Japan. Whether the dinosaur-like beast was a deliberate metaphor for the atomic horrors his country had suffered at Hiroshima and Nagasaki, or merely a response to the Ray Bradbury/Ray Harryhausen collaboration *The Beast from 20,000 Fathoms*, or a combination of both, *Godzilla* would become the first living, fire-breathing icon of the new age – an era brought about by science in the form of nuclear prototypes Fat Man and Little Boy.

To create *Gojira* – a name that combines the Japanese words for 'gorilla' and 'whale' – Tanaka joined forces with director Ishiro Honda and with effects maestro Eiji Tsuburaya, who, like Ray Harryhausen, took inspiration from Willis O'Brien's work in *King Kong*. But Toho Studios lacked the resources to create monsters via stop-motion animation, forcing Tsuburaya to develop the retroactively-named 'suitmation' approach, featuring performer Haruo Nakajima in a monster costume. Through the efforts of Nakajima and chief cameraman Teisho Arikawa, Tsuburaya provided a menacing creature and creditable effects for Tanaka's movie, which proved to be an instant hit upon its 1954 release in Japan. In 1956, American mini-mogul Joseph E. Levine acquired U.S.



*The gargantuan star of countless Japanese monster movies made a Hollywood-style comeback with the summer release of *Godzilla* from TriStar Pictures and Centropolis Entertainment. While the original low-budget films had relied on a man in a suit to depict the skyscraper-size reptile, the current incarnation was predominantly a digital character inserted into both live-action and miniature photography.*



Several facilities teamed up with the in-house Centropolis Effects to realize the effects, all of which were overseen by visual effects supervisor Volker Engel. In the opening scene, a Japanese fishing vessel is attacked from underwater by Godzilla. At a film tank in the California desert, Engel inspects a thirty-five-foot-long model representing the cannery ship built by Cinnabar and

distribution rights to *Gojira*; and, after undergoing the requisite dubbing and some recutting – to emphasize newly-shot footage of a pre-Perry Mason Raymond Burr – *Godzilla*, King of the Monsters made a surprisingly formidable debut stateside.

photographed by Sightline Productions, a company formed by Director Roland Emmerich, teaming again with producer and co-writer Dean Devlin, was determined to bring a nineties sensibility to the decades-old icon.

The international success spurred Toho to produce a rash of sequels and spin-offs. A whole new subgenre of Japanese cinema came about as a result, with competing studios creating their own monster-based franchises. The 1960s saw Japanese films featuring all manner of strange creatures, from Gamera the flying turtle to the gigantic insectoid Mothra. Most Toho releases centered around activities on Monster Island, *Godzilla*'s resident haunt in between those city-flattening sojourns to Tokyo. *Gojira* follow-ups would vary in quality, with international marketing becoming more and more of a concern. *King Kong vs. Godzilla* went to the extreme of presenting a subtly altered, tailored-for-America finale implying the great ape had bested *Godzilla* – though in the version seen outside the U.S., the results were reversed.

While his trademark roar remained undiminished, *Godzilla*'s menace grew ever more slight in his new role as earth's defender against a variety of terrestrial and extraterrestrial invaders. After pairing up with his smoke-ring-breathing, bungling-but-adorable offspring in *Son of Godzilla*, the Big Iguana's next transformation – which proved far more insidious than the nuclear mutation that unleashed him upon the twentieth century – was a foregone conclusion: *Godzilla* would become a warm and fuzzy superhero to children worldwide. When the inevitable merchandising blitz led to the creation of *Godzilla* plush toys, the terrible metamorphosis was complete. *Godzilla* had been reduced to the sound and the furry.

Following a failed medium-budget attempt to rekindle interest with *Godzilla 1985*, *Godzilla* hit a major slump in the nineties. Even as superspy *James Bond* found himself upstaged by *Die Hard*'s John McClane and *True Lies*' Harry Tasker, *Godzilla* was unseated as heavyweight champion by the original lizard-kings of *Jurassic Park*. But now, with Roland Emmerich's *Godzilla*, the giant Japanese export has come back strong, and in a big-budget way.

Co-executive producer Robert Fried first had to obtain the rights from Toho to produce an American version of *Godzilla* in concert with TriStar Pictures. Fresh from the megahit *Speed*, Jan DeBont agreed to direct the movie, which at that time was based upon a screenplay featuring *Godzilla*'s eastward march across North America and a mano-a-mano between *Godzilla* and the Gryphon, yet another oversize beast. Budgets spiraled upward, and the combined expense of pulverizing the continental U.S. and depicting a pair of dinosaur-size monsters duking it out in the city that never sleeps was projected to exceed \$130 million; and so *Godzilla* went back on ice.

Enter Centropolis Entertainment, the production company founded by Emmerich and producer Dean Devlin, who had created the phenomenally successful *Independence Day*. "Over the course of one year," Emmerich recalled, "I was asked to do *Godzilla* several times. Each time I said 'No' – because this was the product of a certain time period, and the qualities it possessed belong to that time. But finally I realized *The War of the Worlds* was also a product of its time, and yet we re-thought that and came up with *Independence Day*. This picture could retain a certain 'monster movie' feel while featuring our own, original elements. So I told Sony and Toho that I would do the film – but on

my own terms, with *Godzilla* as a fast-moving animal out of nature, rather than some strange kind of creature.” Committed to the notion that the beast taking a bite out of the Big Apple was a sure-fire crowd-pleaser, Emmerich and Devlin – who would also write the story – elected to contain *Godzilla*’s American pilgrimage to that single city. By reducing the sheer acreage of devastation and eliminating the Gryphon, the duo brought the project’s budget down to a more reasonable high eight figures – and *Godzilla* was finally a ‘go.’

The filmmakers were determined to take the creature in an entirely new direction, however. “We could have just celebrated the kitsch,” commented Devlin, “but that’s not Roland’s sensibility, and it isn’t mine either. The alternative was to reinvent *Godzilla* as a modern horror movie, one in tune with the tastes of today’s moviegoers.” That commitment to putting a new, nineties spin on the film did not keep the team from screening the original in search of inspiration. “Roland and I were surprised by the serious tone of the original, but also very impressed with the high quality of the model work. They had been smart enough to set a lot of the action at night and in the rain, which also helped out a helluva lot.”

Emmerich and Devlin opted to set the new film in similarly gloomy conditions, not only as a means of portraying the creature through the flattering filter of rain and fog, but also to give the movie a more noirish, frightening tone. To realize the creature and the destruction he leaves in his wake, the production engaged the services of effects veterans who had contributed to *Independence Day*. Returnees included visual effects supervisor Volker Engel, mechanical effects supervisor Clay Pinney and miniature effects supervisor Joseph Viskocil. Production designer Oliver Scholl and visual effects director of photography Anna Foerster also settled back into their former posts for another tour of duty with Emmerich.

New to the lineup was associate visual effects supervisor Karen Goulekas, who joined the Centropolis team at the end of principal photography and oversaw the enormous digital demands of the production. So complex was the CG assignment, several companies contributed. VisionArt developed early previsualizations of a CG *Godzilla*, utilizing motion capture techniques, and attempted some motion capture shots for the film – although key-frame animation was ultimately favored. Additional digital work and compositing was handled by Digiscope and Sony Pictures Imageworks. Viewpoint DataLabs and Softimage



Before *Godzilla* is spotted – having been spawned by nuclear testing in French Polynesia – evidence of his existence is discovered in the form of enormous footprints in Panama and a beached ocean freighter in Jamaica. Although a few footprints were carved into the ground at the filming location in Hawaii, others were digitally painted at VisionArt and incorporated into live-action plate photography filmed from the air.



would provide, respectively, the means to model and animate the highly detailed and complex title character. Planted squarely in the middle of the action was Centropolis Entertainment, which, in the process of setting up a small permanent digital effects team dubbed Centropolis Effects, would find that group expanding exponentially as production progressed, ultimately taking on the lion's share of character animation.

VisionArt also rendered the wrecked freighter. The computer model, fashioned in 3-D to accommodate a sweeping camera move and its consequent perspective shift, was composited into aerial beach plates also photographed in Hawaii.

Miniatures – both old and new – came from various sources. Cinnabar, a veteran of countless TV commercials and entertainment construction projects, provided a thirty-five-foot freight ship for the opening sequence, along with boats, tanks, tunnels and the Brooklyn Bridge in both sixth and twenty-fourth scale; Hunter/Gratzner Industries supplied breakaway replicas of key architectural landmarks; Michael Joyce and his team at Cinema Production Services built interior and exterior versions of *Madison Square Garden*; Larry Jolly Miniature Productions delivered eighth-scale Apache helicopters; Stirber Visual Network built taxicabs and fishing boats; and Gene Rizzardi retrofitted a bevy of rented miniatures.

Patrick Tatopoulos another ID4 alumnus, was charged with designing a *Godzilla* for the nineties, then translating that design to a man-in-a-suit effect, as well as to a variety of full-size and scaled *Godzilla* props. “Roland told me to go crazy with it and not be a slave to the original design,” Tatopoulos recalled. “I could have just tweaked the old design, essentially modernizing it; but, after hearing Roland’s views, that seemed less respectful than taking a whole new direction with it. The old *Godzilla* is what it is, cartoon eyes and all. The new *Godzilla* has the same spirit, but it inhabits a different form. The old *Godzilla* was a lumbering beast, whereas this would be a sleek and agile animal – *Godzilla* after fitness training.”

While some character designs take months to develop, *Godzilla*’s design evolved quickly, out of only five sketches. Those sketches reflected elements from two different creatures, one of which was fictional. “In Disney’s animated *The Jungle Book* there is a tiger named Shere Khan,” Tatopoulos recalled. “The character had a great sense of nobility; and part of that came from this incredible chin. No animal I know of has a chin like that, and yet I found it in my first drawing of *Godzilla*. Tigers are also very sleek and move with a sinuous controlled quality, which is something Roland wanted. Crocodiles, on the other hand, have a stiffness to them. Instead of whipping their heads around to stare at you, they just stop; and it is that sudden lack of motion that telegraphs their awareness of your presence. Then they move. I wanted this bit of nature in the creature. When I see a croc at the zoo, it does not have to be in motion for me to know that it is alive. Puppeteers can sometimes make the error of constant motion, with many parts moving all the time. It looks cool, but it doesn’t mirror reality. This creature is most compelling and draws your eye most completely when he suddenly halts and holds completely still.”

When Emmerich reviewed the sketches, he bought off on the concept at once. The next hurdle was getting Toho’s senior executives to accept this new incarnation of *Godzilla*, presented in maquette form. “Their initial reaction was a gasp,” remarked Tatopoulos, “and they asked for time to think it over and give us an answer the next day.” Emmerich, Devlin and Tatopoulos spent a long, anxious night before finally getting an enthusiastic thumbs-up from Toho. “After the design was approved,”

said Devlin, “Toho sent word that if the technology had been available to design the creature in such a manner back then, their *Godzilla* would have probably resembled the creature we came up with. Dollar and technology limitations forced them to go with a man in a suit, but it wasn’t necessarily what they wanted – it was more a matter of practicality.”

With a Tatopoulos-built maquette in hand, Centropolis now had an artistic representation of their prospective movie’s lead character. But before committing further to the film, Emmerich and Devlin needed to know that the creation and animation of the character was viable. VisionArt produced an initial proof-of-concept test of the creature in action. “Dean and Roland wanted to see what was possible to achieve with the creature before they committed huge resources to the project,” stated VisionArt president Joshua Rose. “This test was entirely motion capture, even though we knew that Centropolis Effects would be doing the creature with key-frame animation.”

The motion capture session convinced all parties that the digital creation of *Godzilla* was more than a mere possibility; and, at that point, the beast’s performance became the focal point of Centropolis Entertainment’s in-house effects unit. CFX first approached Viewpoint DataLabs International about digitizing and modeling ‘Fred’ – as the digital *Godzilla* came to be called. “They brought this three- to four-foot plastic-and-resin model,” recalled Viewpoint vice-president of production Walter Noot. “There were a great many questions about how the creature would move and what kind of animation software would be used.” The CFX team felt strongly that a patch-based NURBS model would work best, particularly for the kinds of deformations that would be present in an organic creature. “At that point – and, indeed, this would remain the principal question throughout our involvement – our focus revolved around the matter of creating tangency in a NURBS model. How do you maintain continuity going from one surface to the next without getting seams? That had to be resolved for this film if the character was going to come off. Our senior digital sculptor, Steve Keele, spent time with CFX CG supervisors Carolin Quis and Steffen Wild, and with Softimage personnel, to deal with both this question and the question of how to make all NURBS models compatible with their new software. With Viewpoint on one side handling modeling issues and Softimage on the other coming up with new ways to convincingly animate the creature, the staff at Centropolis was able to avoid getting bogged down by technical matters and to concentrate more heavily on the aesthetics of the character.”

As head of Softimage’s special projects and content group, David Morin had interfaced directly with effects artists at a variety of companies in past years. For *Godzilla*, Morin would involve developers from special projects groups throughout the world, although the effort would be centered in Los Angeles with Olivier Ozoux, local team leader. “We analyze problems, put solutions on the table, and then implement them,” Morin elaborated. “Conventional wisdom in the marketplace calls for Alias when modeling, Softimage for animation and RenderMan to render imagery. We examined all three programs carefully to determine which features inherent in each make such a difference. Together with CFX, we analyzed Centropolis’ particular needs for this production, knowing they wanted to work efficiently and minimize the need to translate between different products or buy a lot of packages that were not absolutely essential. Since there were some features Centropolis needed that were not present in Softimage, we developed these as plug-ins or subcontracted them to third parties like ImageWare, an Ann Arbor-based company with excellent modeling engine

technology.” The Softimage/ImageWare connection ultimately produced a tool capable of gluing patches together, thus resolving the tangency issue.

Equipped with new tools from Softimage, CFX began building its *Godzilla* model, made up of an inverse kinematic skeleton constructed by Wild and Quis and surfaced with a variety of texture maps. “Patrick told us that the creature’s foot was exactly like that of an ostrich,” Wild recalled. “So our lead texture artist, Robin Higgin-Foley, took reference pictures and video at an ostrich farm to give us a starting point for texture maps. Since *Godzilla* needed a thick skin, we included a very basic muscle motion for the creature. But the model had about five hundred expressions and an awareness of its own position in 3-D space. If we dragged the foot forward, for example, the entire creature moved, while maintaining its center of gravity. If there was a change in the ground plane, you’d see a toe splay and curl in automatic response. Even so, we built enough objects in the model to permit animators to override those built-in expressions to achieve a specific effect.” After Quis and Wild became immersed in production, animator Eric Weiss looked after the Fred model to ensure internal consistency.



Off the coast of New England, three fishing boats trailing nets are dragged underwater by an entangled Godzilla. Augmenting a full-size boat – which was submerged via a hydraulic wheel system – were three quarter-scale miniatures.



In a tank at Universal Studios, the models were bolted to an inclined platform and dragged underwater by an off-camera truck.



Rain was a pervasive element in the film, requiring the special effects crew – headed by Clay Pinney – to provide enormous rain delivery systems for nearly every exterior scene.

As the CG team labored on its digital model, Patrick Tatopoulos Designs turned out a corresponding twenty-fourth-scale suit. Once that was approved by Emmerich, pieces were sent to the CG team as reference. Although, in the end, Tatopoulos' practical *Godzillas* would be seen in only two dozen shots – in contrast to the final CG *Godzilla* count of 185 – the initial plan was to rely much more heavily on the scaled suit and mechanical devices. In all, 170 artisans toiled in Tatopoulos' creature shop to produce *Godzilla* pieces of varying scales. "Jurassic Park had it easier in one sense," observed Volker Engel, "since the T-rex could be built full-scale. But we just couldn't do that with a creature twenty stories tall. The biggest piece Patrick's shop built was a sixth-scale upper torso." That torso piece was intended to be used for shots of the beast wreaking devastation on like-scaled miniature surroundings. Even at sixth-scale, the torso – which included both arms and head and was mounted to a motion base – measured a whopping thirty feet high.

Godzilla both digital and practical, was taking a definitive shape by the time filming began in New York in May 1997. The mostly nighttime location shoot lasted a full month, with visual effects supervisor Volker Engel on hand throughout. The challenge for Engel was to orchestrate the logistics of working with Emmerich on first unit while overseeing the second unit plate photography and directing a helicopter aerial shoot. Also on location was physical effects supervisor Clay Pinney. "While I was gone," Pinney explained, "Ross Young, who does my engineering, worked out tolerances for all of the rigs with my shop supervisor, Bill Harrison, and made sure the bugs were gone before anything went to set." Pinney's first unit supervisor, Hans Metz, coordinated the overwhelming logistics of the live-action creature shoots, which on occasions required a hundred-foot rain bar, two forty-foot rain crosses, and up to twenty separate thirty-foot-tall rain stands to realize Emmerich's stormy vision for the movie. "Steve Kirshoff did a terrific job designing



Emerging from the ocean depths, Godzilla approaches a dock where an elderly fisherman has thrown out his line. A sixth-scale head-and-shoulders mockup – constructed by Godzilla designer Patrick Tatopoulos and his Patrick Tatopoulos Design team – was attached to an underwater track by miniature effects supervisor Joseph Viskocil and crew, then propelled toward a like-scaled pier.



The Viskocil unit also rigged the pier with pyrotechnic hits to enhance the effect of the creature's impact. The

those rain crosses, which we hung from articulating Condor cranes. By mounting the cranes in opposition to one another, we could cover an area 180 feet across and ninety feet deep without having anything jutting in at an angle to ruin the camera view.” Two truck-mounted Curtis 1200 Dynafoggers were required to create additional mist. “Roland wanted smoke and rain to give layers to the scene, but more importantly to soften edges on everything, including the creature. *Godzilla* – however he was to be done – would have to be softened for the eye to accept that he was part of this environment.”

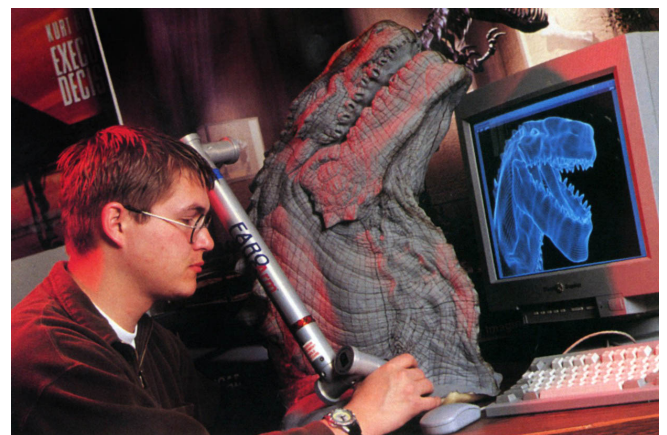
fisherman, running for dear life, was composited into the shot.

Transforming the location into an environment capable of interacting on cue with *Godzilla*’s footfalls was a major undertaking for the physical effects crew. “We built twenty separate car-thumpers,” related Pinney, “converting automotive jacks to work off of foot-long pneumatic cylinders that must have weighed two hundred pounds apiece. There’s an entire line of cars on Wall Street for one shot, and they all jump six inches in the air at the sound of his approach. After seeing that shot, Roland decided to include the car-thumpers in every shot, so that increased the setup times for the rest of shooting.” Debris and fish fell from the sky as *Godzilla* passed, necessitating additional rigs. Using speed rail, Steve Kirshoff made two twenty-by-twenty-foot debris-drop units that hung from cranes. Pool netting held the suspended debris – generally lightweight cement blocks and bricks – which was released by pyro charges. “For one scene looking out at the street from within a diner, we had fourteen car-thumpers, two cars being overturned, and every piece of furniture inside the diner rigged to thump simultaneously – while also supplying rain and smoke and staging another debris drop.”

One effects rig that was intended for the New York location shoot, but did not see action until the production moved to Los Angeles, was a steel plate-drop that would be used to simulate *Godzilla*’s foot. “We wanted to use it to crush a van on Fulton Street,” Pinney recalled. “We’d had a seismic company test it and make sure we were well within established safety guidelines. But even after documenting the procedure, no one would sign off



Godzilla is further revealed as he stomps through lower Manhattan. A month-long location shoot in New York provided the plates into which Centropolis Effects’ computer generated Godzilla was inserted. Compositing chores were divided among CFX and other vendors, all of which added sweeteners such as camera shake, digital debris and jolting cars to sell the beast’s presence in the live-action photography. Practical elements such as rain, fire and smoke – shot by Viskocil’s crew – were also added to the mix.



To provide CFX the raw data with which to create their CG Godzilla, a twenty-fourth-scale model – supplied by Tatopoulos Design – was digitized by Viewpoint DataLabs senior digital sculptor Matt Paulson.

on it. City officials kicked the proposal back and forth like a football – it was an election year.”

The city did cooperate with the production’s huge and intrusive presence on its streets, however – as long as those streets were cleared in time for the morning commute. “Our presence in New York was three times the size of *Die Hard With a Vengeance*,” Devlin marveled. “It was truly an enormous mustering of manpower and trucks. Usually you can just light a single story – after all, your actors aren’t any taller than that – but we had to light twenty stories for our star. And since Roland was panning the camera around, we were lighting up twenty stories for blocks and blocks in all directions. There was a *Godzilla* traffic report each morning, warning commuters where we’d be shooting each day.” To get the most dynamic feel out of the city, location footage was shot almost exclusively with handheld cameras and Steadicam rigs. “Roland realized this would make for a difficult job of tracking and matching, but he just went to the teams at CFX and VisionArt and told them they had to make these shots work. CFX match-mover Joe Jackman and VisionArt match-mover John Schmidt and others rose to that challenge. In *Twister*, there were probably a half-dozen really difficult tracking shots. We had 150, with hand-held cameras following actors as *Godzilla* stomps along behind.” VisionArt’s Zeiss motion tracking equipment was used to record location data, including the sizes of and distances to nearby buildings. CFX and VisionArt then utilized the Zeiss data, along with video reference footage, to reconstruct wild plate elements while retaining the proper perspectives.

For *Godzilla*’s opening sequence – in which a massive ship is attacked and destroyed by a mysterious underwater force – the production rented the Acton tank built for *Titanic*. “We spent two weeks in the desert,” Volker Engel recalled, “shooting this thirty-five-foot model of a floating fish factory, which was built by Cinnabar. Our visual effects art director, Steve Legler, had worked with Cinnabar and recommended them. They’d been around for about fifteen years and had done some theme park work for Universal and Disney; but they were not really known in the motion picture industry. We tried them out on the ship miniature, and their work was so fantastic they wound up getting a lot more. They always delivered more than we asked of them, and I couldn’t believe how well they handled the stress of quick turnaround times. Once we needed a ramp going into a tunnel model, and when they asked about the delivery date, were told, ‘Uhh ... tomorrow?’ And they delivered. Cinnabar is a big shop with many departments, so they were able to borrow personnel and put them where they were needed to complete rush jobs.”

Under the banner of Sightline Productions – the company formed to provide model and miniature photography for the show – the opening sequence was shot at 120 frames per second. “The tank was not terribly large,” stated Engel, “perhaps sixty by sixty feet, and so we found ourselves having to come up with a means to suggest that the ship was plowing along through the water in an area less than twice the length of the miniature craft itself. The only way to accomplish this was to keep the ship static and create the effect of passage through the water by installing underwater pumps that created a wake effect around the bow of the model. Joe Viskocil’s foreman, Emmet Kane, supervised that whole undertaking. We also had crew members in small boats at the edges of the tank to set up rippling wave effects through their own body movements. Coffee grounds created the muddy-water look of deep sea.” Whitewater conditions were simulated through air mortars set up by Viskocil. “We also used black soak hoses – the kind made for gardening – and pumped in air instead of water. That gave us very fine-scale bubbles trickling out from the bow and streaming

backward, simulating the wake of a ship underway.” Viskocil’s crew also equipped the boat model with a hydraulic rig, allowing it to pitch over very quickly during the attack.

For the live-action component of the sequence, shot on set, Pinney constructed three six-foot-long claws from heavy fiberglass to enact *Godzilla*’s breakthrough into the vessel’s hull. Stuntmen were arranged in strategic locations between points where the claws would plunge downward. Hull panels, made from soft aluminum and laminated over a rubber membrane, were pre-scored from the off-camera side to facilitate the claw-through. “Bruce Donnellan designed a pneumatic rig for the push-through and tear-down, plus a series of water jets that went off just as the claws entered,” Pinney recalled. “Then we tripped a 5000-gallon dump tank for the flooding action down the hallway.” *Godzilla* goes largely unseen during this brief and terrifying attack, though a sixth-scale tail – a Tatopoulos skin that covered Pinney’s 25-foot-long steel and bronze assembly mechanism – creates havoc on board. “It was just the tip of the tail, but that was still enormous. We engineered the tail to pivot through about two hundred degrees of side-to-side motion, while also raising and lowering twenty-five percent from center. It was made of steel, balanced with 6000 pounds of counterweights, and quite powerful.” Spectron rope and hydraulic cylinders powered the tail, which moved so mightily through frame that it actually created a visible air vortex out of the airborne dust and debris.

The tail would first see use in conjunction with an intricate quarter-scale ship’s bridge model, also built by Cinnabar and featured in the opening attack. “There was full interior lighting in that bridge model,” Engel enthused. “We shot greenscreen stunt guys being pulled back on cables, then composited that footage into the model photography to populate the bridge as the tail strikes.” Cinnabar built their four-foot model – in actuality, a series of them, as duplicates would be required for multiple breakaway shots – from reference photos taken by Steve Legler on the full-size bridge set. “A variety of metals and plastics found their way onto the bridge model,” related Cinnabar president Doug Morris, “both to create correct textures and to be able to break away in a credible manner. The reference photos pulled double duty, as we were able to make transparencies and mount them inside the bridge miniature. With backlighting, those became radar screens and monitors.” The differing scales of bridge and tail proved acceptable in this single scene due to the audience’s unfamiliarity with the creature.

When a wrecked cargo ship is found on a beach in Jamaica, scientist Nick Tatopoulos (Matthew Broderick) – named in honor of Patrick Tatopoulos – arrives via seaplane to investigate the cause of the destruction. The ship was created digitally by VisionArt. “Centropolis sent us a helicopter tracking shot from their location shoot,” Josh Rose elaborated, “which had Hawaii standing in for Jamaica. We had to create the ship while repositioning some live-action elements – people in the foreground, helicopters which were flying way too low in the background – to keep them from being obscured when the boat was added. The helicopter plate move took us right over the ship, so we had to create a vessel to be seen close up all the way through a major perspective shift. We also animated CG nets blowing in the wind on top of it.” While a few full-scale footprints had been made at the Hawaii location, additional prints receding into the distant forest were required. “Using tracking points and our proprietary 3-D camera tracking software, we built a CG footprint based on *Godzilla*’s true size, which differed from the location footprint. Roland liked it so much he decided he wanted us to redo one of the practical full-size prints.”

As the story progresses, some fishing trawlers off the New England coast inadvertently net the creature and are dragged backwards before being towed underwater. A pond at Universal Studios served as the setting. “We intercut between quarter-scale fishing boat models getting pulled underwater and a full-size boat – rigged by Al Broussard and his second unit crew-going down, as well,” explained Engel. After cutting holes in the boats so that water would go through them and permit submersion, the crew bolted the models to a large steel platform. Set on a diagonal incline leading deeper into the water, the platform setup was powered by a giant tow truck which yanked the boats back and down.



Among the practical Godzillas produced by Tatopoulos Design was a sixth-scale, thirty-foot-tall animatronic upper torso, attached to a motion base. Patrick Tatopoulos makes an adjustment on the rig prior to filming.

The full-size boat – built open at the bottom, with two-foot diameter PVC tubing installed to keep it temporarily afloat – was also dragged through frame by the truck, which attained speeds of approximately twelve miles per hour on the short run-up. “Al Broussard designed and installed a hydraulic wheel system that rode on welded trench plate after removing the PVC float system,” said Pinney. “The boat started out level, then reached a point of the incline where it would tilt and begin to sink. There was a scuba diver down there who would activate the hydraulic wheel system to lower the boat at the end of its run, when all but the top of the cabin was completely underwater. After each successful take, Larry Roberts – Al’s key guy on second unit – would go in and redress, since the single full-size boat had to stand in for all three boats.” A follow-up shot, beginning with the boats already submerged, was accomplished by tying the models down underwater. Cable cutters cut them loose on cue, allowing them to pop up out of the water, similar to breaching whales.

After the opening, *Godzilla* emerges from the Atlantic, still festooned with fishing boats caught up in his fins. The shot utilized a sixth-scale *Godzilla* head and pier, filmed in real water outdoors. Viskocil crew members Emmet Kane, Mick Duff and Joe Heffernan rigged a miniature fiberglass and latex head-and-shoulder prop – provided by Patrick Tatopoulos Designs – on tracks, causing it to rise slowly before crashing into the pier. The interaction of the creature actually plowing through the pier was created with pyro hits.

The first big reveal of *Godzilla*, however, does not occur until the creature makes landfall. That reveal, and subsequent shots depicting *Godzilla* moving through the streets of New York, would fall largely to CFX – although, as principal photography was nearing completion, the production team was still weighing VisionArt’s motion capture against a key-frame approach. Karen Goulekas, who had just joined the project – fresh from *The Fifth Element* –



Tatopoulos also provided a twenty-fourth-scale animatronic head and body suit, worn by a performer and filmed either against greenscreen or in conjunction with same-scaled models. Electronics crew member Gary Martinez makes adjustments to the head mechanics.



*Sightline Productions on-set model lead Tony Ciccarelli prepares the costumed *Godzilla* performer for shooting. Ultimately, nearly all of the practical *Godzilla* shots were replaced with computer generated versions.*

campaigns vigorously for the latter. “I had seen motion capture used quite successfully for human motion at Digital Domain,” Goulekas recalled. “But while the VisionArt approach to the creature was technically feasible, I was not convinced that we would be able to get the lizard-like motion we were seeking out of a human skeleton. I was also concerned about using two approaches for the same creature. We’d be intercutting between techniques produced in separate pipelines and that featured different lighting, texturing and renderers. I was a firm advocate of using one animation and render pipeline for all the *Godzilla* shots in order to maintain continuity of look and style.”

Key-frame animation ultimately was chosen as the preferred approach, resulting in more shots being loaded onto Centropolis’ plate. Consequently, the number of animators on payroll at CFX – initially, a mere twelve – grew to sixty. The effort to set up Centropolis Effects on the run and then see it expand exponentially during production impacted on every department – especially since a diverse technological base had to be developed in service to the artists. “All sorts of general tools were needed,” related CFX R&D chief John Lewis. “We were writing glue code to go between all of the standard packages; and then there was the matter of establishing a whole rendering pipeline. What saved us was not getting bogged down in the usual politics. We could have a hallway meeting, get the answers we needed, then proceed with the job – which was a great way to keep everyone’s enthusiasm high.”

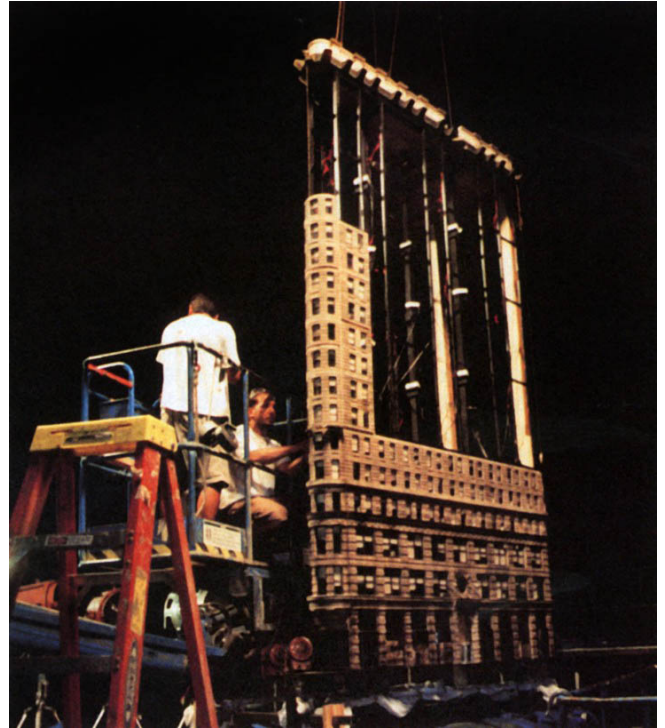
With the growth came an enormous surge in productivity, spurred by Emmerich’s approval of a look for *Godzilla*’s movement. “Roland became very fond of the animation style developed by the CFX animation team, led by Andy Jones,” recalled CFX president Steven Puri. “That was the real turning point for us on the show.”

“At first, the animators tried moving him faster through the frame to keep up the enormous speed Roland wanted,” noted Goulekas, “but he just seemed smaller and smaller, and he began to lose his mass. Increasing the amount of ground covered by each stride, resulting in a half-second of air time with both feet in the air, helped to sell his velocity while allowing him to retain his mass. We had to tightrope the fine line between Roland feeling like *Godzilla* was moving too slowly and the point where he could travel at an insane speed while still maintaining the heaviness inherent in a creature of that size.”

“We realized that slowing *Godzilla* down somewhat, just as you would in a high-speed model shoot, gave us more credible results,” Emmerich stated. “Once we had nailed a good walk cycle, everything else went easier. We saw how this animal fit into the film, and we started lighting him dramatically. Sometimes we gave *Godzilla* a backlight which shouldn’t really be there in the plate. But it wasn’t any different than providing an eye light for an actor or a kicker for some important detail. I told the technical directors to light *Godzilla* like he was a film actor – make him look good.”

In the final composites, it wasn’t just the movement of the creature that suggested his weight and mass, but also his impact on the surroundings. “Via physics,” said CFX compositing supervisor Mitchell Drain, “somebody worked out how much *Godzilla* would actually weigh – and the figure was astronomical. As a result, he kicked up tons of debris and broken pavement with every footstep. Any car in sight had to jump up when his foot came down, regardless of whether it had actually been rigged on set or not. So that became a compositing issue. The first time we’d see a comp there

would be all these great ideas for enhancing the creature's presence. But then each of those sweeteners would have to be added, not just to that shot, but to the rest of the shots as well."



Live-action captured during the New York location shoot was augmented considerably with cityscape miniatures. For scenes in which missiles targeting Godzilla strike landmark buildings instead, Hunter/Gratzner Industries built breakaway twenty-fourth-scale replicas of two famous structures. Modelmakers Kirk Yamashita and Paul Clemente assemble the distinctive Flatiron Building in a hangar at the abandoned Hughes Aircraft facility in Playa Vista.



Mechanical effects technician Gil Levin attends to the Chrysler Building miniature, which was air-actuated to initiate the toppling of its dome after missile impacts.



A separate twenty-fourth-scale setup was used to show the dome – flung from a catapult on stage – crashing into the street. Joe Viskocil rigs the dome model with pyrotechnics.

Compositing for the creature's initial reveal and follow-up daylight shots was all accomplished in house. "Originally the daylight sequences were rendered using Mental Ray," Goulekas commented. "In many ways Mental Ray has given RenderMan a run for the money through its use of ray-tracing. But it's a lot slower. With displacement mapping and motion blur on, render times were just crazy." For close views of the beast, displacement maps – featuring geometry with true divots and bumps – were a logical choice, since two-dimensional bump mapping could only imply through illusion the depth and contours of the creature's fins, and then only from a limited perspective. "I insisted on converting over to RenderMan and displacement mapping in order to maintain the photorealism that we were looking for. We just couldn't get the look we needed with traditional bump mapping, and the Mental Ray pipeline had prohibitive render times with displacement mapping and motion blur turned on. The RenderMan solution saved us hours of rendering time and gave us the look we wanted." Multilayer passes – developed by lead lighting artist Frédéric Soumagnas – included a beauty pass, a wet pass, an iridescent pass and multiple RGB lighting passes that allowed the compositors complete control over lighting intensities and environment.

After he rises from the Atlantic, *Godzilla* passes through the Fulton Fish Market and then makes his way onto Wall Street, boats occasionally falling off him as he strides through town. Full-size fishing vessels were dropped from cranes and filmed against greenscreen in a parking lot at the abandoned Hughes Aircraft facility in Playa Vista. Also filmed there was the shot of *Godzilla* picking up a fish truck and attempting to devour its contents. "We took a full-size fish trailer down to Hughes," Clay Pinney explained, "then we made breakaway sections from aluminum and balsa wood so twelve teeth could punch through the sides. We put the trailer on a lift so it would tip up into the air, then had stuntmen drop out after the teeth break through – but within the same take, as if *Godzilla*, having bitten the truck, was now picking it up." Steve Kirshoff designed the adjoining cab for the follow-up to *Godzilla*'s seizing of the fish truck. "He engineered the truck's cab to rise on a crane rig with a stunt guy inside. We mounted the camera inside, too, looking toward the driver, so you could see the perspective of the city change as he's pulled skyward. A trip was built in so that at a certain height, the cab pivoted over ninety degrees, leaving the stunt driver dangling out the door, clinging to the steering wheel. Then he lets go and falls into a bunch of fish boxes." The last part of the stunt was cut when a happy accident on the



The remains of the Chrysler Building dome after impact. HGI produced storefronts which were mounted onto rented building models for the setting, while Michael Joyce and his Cinema Production Services created streets, sidewalks and set dressing.



The Flatiron Building under missile attack.

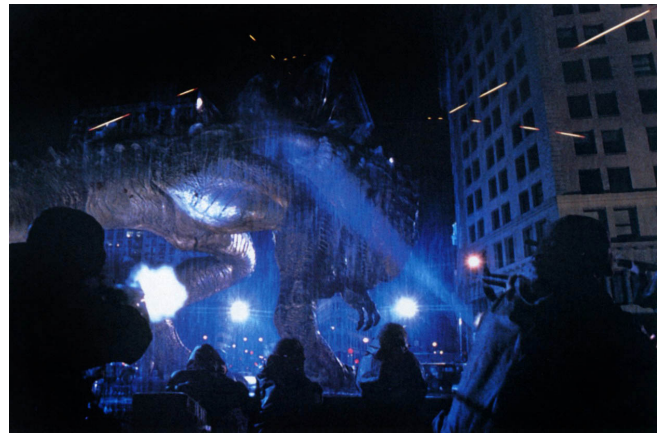
miniature setup produced even more startling results. “We had *Godzilla* shaking the sixth-scale truck,” recalled Volker Engel, “and hanging from the cab was a little figure with rubber-band joints. This puppet accidentally came loose in the middle of the take and went flying past camera – and it looked great. The live stunt was terrific, but that miniature toss-off was so good the stunt had to go.”

During *Godzilla*’s day trip through the city, television cameraman ‘Animal’ Palotti (Hank Azaria), in the process of getting a candid closeup shot of the beast, is nearly flattened by one mighty footfall. As luck would have it, the cameraman freezes in place – standing at the very spot where a gap exists between *Godzilla*’s toes. “It was the arched groove between its talon-like toes,” recalled Tatopoulos. “That was one of the very few parts of *Godzilla* built full-size.” In the course of his journey, *Godzilla* does manage to step on a lot of things, especially cars. To safely convey the pulverizing effect of the beast’s foot impacting on vehicles, Clay Pinney developed a system utilizing structurally weakened autos. “Before setting a car in place, we would pull the engine and drain all fluids. Then we would drill the tires to eliminate any bounce from the rubber and set the car on balsa wood blocks atop a steel plate that protected the street and spread the impact outward. To simulate the foot coming down, we started out with a 9000-pound steel weight, then increased it to a 12,000 pound version measuring seventeen by eight feet, fashioned from inch-and-a-half steel plates. We’d hang it from a crane, thirty feet up, and position it over a car, then use pyrotechnic cable cutters to drop it. Suddenly the car would be only fourteen inches tall.”

Surprisingly, obtaining real cars proved cheaper than constructing detailed miniatures from scratch. “Production found a source for automobiles,” Engel remarked, “which maybe cost them between eight and fifteen hundred dollars per vehicle. After doing a few drops, we realized it was a lot more fun to drop the plate on just a portion of the car. That way we could put the creature’s foot in at the crush point but leave the toes – which would not be flush against the ground – resting on the unflattened part of the car. In dropping the plate this way, we’d get hoods popping open and windows blowing out – all sorts of bonuses in addition to the big crushing action.” To augment the full-size destruction, some eighteenth-scale automobiles – commercial die-cast metal toys – were used in miniature street scenes. But the stalwart, kid-proof



*After discovering that *Godzilla* has taken refuge in the subway system, city and military forces lure him back to street level with a huge pile of fish. Taking the bait, *Godzilla* breaks through the pavement above the 23rd Street subway station and comes face to face with biologist Nick Tatopoulos (Matthew Broderick).*



*The military resumes its attack on *Godzilla* after he surfaces. CFX key-frame-animated nearly two hundred *Godzilla* shots for the film, although some of the animation was composited and enhanced with interactive digital effects at Sony Pictures Imageworks and Digiscope.*

constructs resisted all destruction efforts. Even driving a forklift over them left the chassis largely unaffected, necessitating molds be taken to create easily crushed plastic versions.

Godzilla's daytime sojourn eventually moves into night. For three nighttime sequences, CFX – unable to both animate and composite all of the sequences featuring *Godzilla* – entered into an arrangement with Sony Pictures Imageworks. Centropolis would provide Imageworks with Softimage scene files including the animated *Godzilla*, 3-D tracking data and background plate, as well as all the RenderMan shaders and texture maps. Imageworks would light and render and add animation effects such as buckling pavements and building debris, then composite all of the elements.

The first problem faced by Imageworks visual effects supervisor Jerome Chen and CG supervisors Jim Berney and Scott Stokdyk had to do with lighting the creature for *Lost World*-style scenes within the city. “Nearly one hundred shots dealt with *Godzilla* in a rainy urban night environment,” explained Chen, “requiring a large amount of effects animation to really sell his presence. To supplement the huge library of elements Volker had shot, we had to generate digital debris using particle and collision systems. There was so much happening, it was rare to find a shot with what we'd call invisible compositing, like adding a matte-painted background or a single layer of atmosphere. Everything we did involved *Godzilla* affecting his environment. In addition to kicking up a ton of debris, he also leaves enormous footprints, so there was a development phase during which we had to figure out how to animate the pavement cracking open under his weight. One of our senior technical directors, Thomas Hollier, came up with that street impact technology, which did more than anything else to sell the compositing of the creature into these plates. CFX had provided us with setup files for a Houdini animation test of the pavement cracking; but they liked what Thomas did, so we sent that over to them to use on other sequences. We traded data and technology back and forth throughout the production. There was no compatibility issue, as Houdini, RenderMan and Softimage were already in use by both companies.”

A variety of lighting and atmospheric effects also had to be incorporated. “In the space of five blocks,” said Chen, “*Godzilla* might pass through orange-colored sodium lamps and bluish arc lights, so we had to incorporate those elements with the creature in 3-D space while dealing with the foreground mist as well. For some location scenes, main unit had a dozen xenon lights aimed up at *Godzilla*'s location, but the beams just lit up the buildings behind because there was no creature. Adding *Godzilla* caused him to occlude those beams, which meant tons of work painting out the light on the buildings, while at the same time animating a CG light beam across *Godzilla*. It was worse when he went rampaging through streets, because he'd be taking out stoplights with almost every step. Again, we'd have to paint out the real stoplights after he went through them, as well as create and animate CG stoplights to show the moment when he hit them. This all happens so fast you barely notice it; but if we had not put those animation bits in, you'd realize how much was being missed.”

Additional 2-D animation provided nuances to integrate the digital *Godzilla* with his live-action environment. “As the shots progressed,” said Chen, “it became pretty common for Roland to ask for cars to bounce as the creature runs by – cars that were stationary in the plate.” Imageworks compositing artists created rotoscope mattes for the parked cars and animated the elements by

hand, timing them to the passage of the creature. Liberal uses of post-added camera shake provided a final touch to convey the sense of *Godzilla's* mass as he runs past.

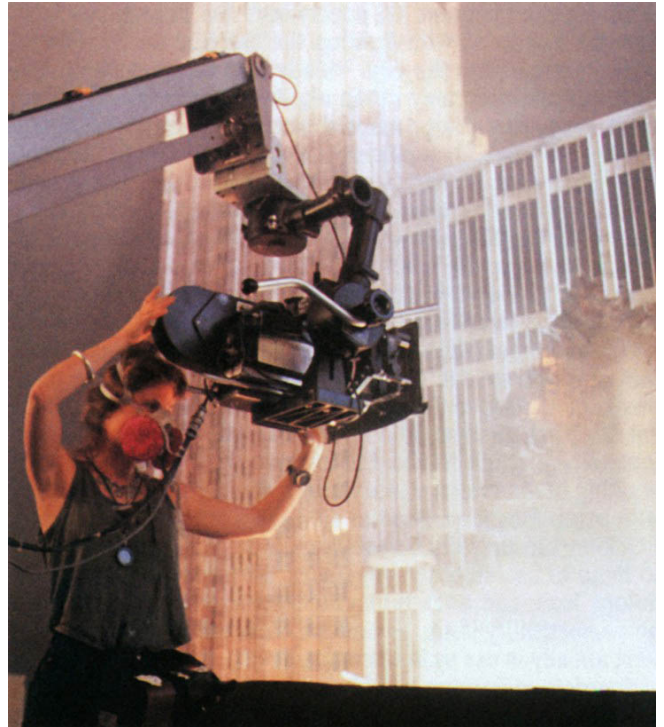
While the location shoot in New York had provided plates for much of the film's action, eight months of miniature photography were also required, orchestrated by Volker Engel and his Sightline crew, with Bob Hurrie as producer and Don Baker as miniature visual effects supervisor. "Perhaps twenty percent of all miniature shots included the twenty-fourth- or the sixth-scale creature," observed Engel. "Don Baker and Anna Foerster shot hundreds and hundreds of elements, from the collapsing Flatiron and Chrysler buildings to tunnels, tanks, cars, street backgrounds, the Brooklyn Bridge and, of course, the *Madison Square Garden* interior and exterior."

Sightline also amassed an enormous library of interactive elements, orchestrated by Joe Viskocil's crew, which would be composited again and again at a variety of scales in countless shots. "We spent a year shooting elements that would tie digital *Godzilla* in with his surroundings," related Viskocil. "Those elements were just as vital to making the creature look real as the CG components were. We shot both miniature and full-size rain elements, wind, explosions, debris, smoke, shattering windows, bursting water mains and fire hydrants – all to create the illusion that this character was there in the environment."

Those elements were all tied to twenty-fourth-scale model streets to suggest *Godzilla's* passage through the city. Building miniatures left over from earlier productions were obtained to make up the scaled streets. "Some were Digital Domain miniatures from *The Fifth Element*," recalled Engel. "Others came from Universal – those buildings first created by Stetson Visual Services for *The Hudsucker Proxy*. Our visual effects producer, Terry Clotiaux, had rented them for *The Shadow* and already determined how they could best be shot – which was useful, as we didn't have time to reinvent the wheel on this show."

Gene Rizzardi, fresh from co-supervising construction of the *Titanic*, formed a small model support crew to assist Sightline. His team spent five weeks refurbishing the old Hudsucker and *Fifth Element* buildings, focusing on giving them new and detailed street levels. Shop foreman John Hess, with Caius Man and Tony Ciccarelli, set up and rigged the miniatures. Brothers Scott and Mark Valdes expertly matched paint finishes to restore damaged rental buildings, while moldmaker Bruce MacRae mass-produced mailboxes and other pieces to be crushed or buried. "For debris drops," stated Rizzardi, "we affixed racklike structures to the surface of these model building shells. I'd have ten or eleven people building debris for these racks. There was an area of the shop ten feet deep and fifty to sixty feet long filled with debris, along with garbage cans packed full of the broken buildings – and the debris came in all shapes and sizes, from slabs six or seven feet across down to three-sixteenths-inch bits. We needed that variety, as the work varied from sixth-to half-inch scale."

Viskocil crew members Thom Zell and Daren Rouse rendered realistically imploding buildings throughout the lengthy model shoot. "We used cable pulls," Viskocil stated, "that attached to facade interiors on one end and sandbags on the other. Individual trips would release a sandbag, pulling the cable and yanking the breakaway section inward. If there was supposed to be a tail sweeping through the building, as many as a dozen of these trips were triggered sequentially to establish the path of destruction. Then the CG tail would be animated to match up with that path."



The military launches a full-scale aerial offensive, with helicopters firing on the creature as he crashes his way through towering skyscrapers. Visual effects director of photography Anna Foerster shoots a helicopter POV of a building model, complete with gaping hole left in Godzilla's wake.



In a reverse-angle composite, helicopters approach the hole in the building and begin firing inside. Digital aircraft rendered by SPI were used to realize the sequence.

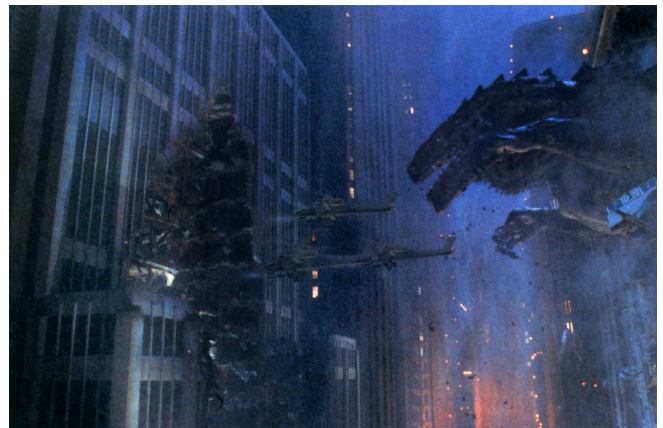
The miniature shoot also utilized a dozen Cinnabar buildings to reveal the aftermath of *Godzilla's* rampage in the city. "We got every kind of reference on destroyed buildings we could lay our hands on," Doug Morris recalled. "There were *World War II* photos from cities flattened by aerial bombardment, and material on the Oklahoma City bombing." Morris found on-screen credibility to be, in large part, dependent on nearly invisible work – hence the need for hand-laid bricks in breakaway wall pieces. "There are irregularities in the real world, and while it takes time to reproduce and miniaturize them, we found that it was worth the effort. Real bricks are never perfectly arranged – there are always edges that have gotten hit and chipped. Including that kind of detail can transform a good-looking model to a successful duplicate of reality that works on every level. This was especially important with the Brooklyn Bridge at the end of the picture. We could not have that bridge model collapse like a big piece of pyrocel or plaster. Volker was adamant about getting that aspect of reality, and we art-directed these breaks so that the bricks would go flying out toward the camera in a believable fashion."

Among Cinnabar's creations was a partial replica of the Metropolitan Life Insurance Building – after *Godzilla* has stomped through it. "There's a tilt-up from live-action soldiers," stated Engel, "revealing this hole in the building which helicopters fly right through. We shot the twenty-fourth-scale Met Life hole static, then plugged it into the Vistavision live-action plate and added a post tilt. This was a good example of how our stock miniature elements came into play, since there were all these broken water pipes and sparks visible within the building."

Rizzardi's crew set up reconfigured versions of the Hudsucker and *Fifth Element* buildings – for the Met Life aftermath and other shots depicting wake-of-*Godzilla* devastation – as compositional elements to help fill out the frame. "We used these buildings over and over," said Rizzardi, "from July to February. We'd remove and exchange their tops to create new



Joe Viskocil loads pyrotechnics into an eighth-scale model helicopter, which was hung on wires for a shot of the craft exploding into a skyscraper.



Bursting through a building across the street, *Godzilla* launches an attack on the helicopters. SPI composited the shot, and also provided CG tracer fire and impact pyrotechnics.



silhouettes. All of them had lightbox interiors, with many sporting dioramas. We had little fantasy rooms inside some of the buildings. *Batman* had a lair in one, while another held the *Titanic*; and there was a *Godzilla* that traveled from building to building as a good luck charm.”

*As the aerial attack intensifies, Godzilla makes his way to the West Side Highway. Volker Engel inspects the miniature set, comprised of buildings originally constructed for *The Hudsucker Proxy* and *The Fifth Element*, refurbished for *Godzilla* by a unit under model supervisor Gene Rizzardi.*

Two New York landmarks were selected to meet sad fates as a result of misguided Air Force missiles, the first of which *Godzilla* simply ducks. Hunter/Gratzner Industries contracted with Centropolis to provide breakaway miniature replicas of the slender, three-sided Flatiron Building and the art deco Chrysler Building. Both twenty-fourth-scale models were transported in pieces to the Hughes facility, undergoing assembly on set just prior to destruction. “A large fireball explosion going off would have covered a multitude of defects,” asserted Matthew Gratzner, “but we didn’t go that route. Volker wanted to see a flashbulb type of initial explosion rather than the usual ‘this structure is filled with gasoline’ kind of blast. When real buildings are demolished, they collapse under their own weight. With the Flatiron, we decided to try to duplicate that demolition effect, but design it to camera to best showcase the building’s unique triangular design. The roof came down just slightly while the whole building fell in on itself and collapsed straight down. Instead of using snow plaster, which is aerated and brittle, we constructed something a bit more substantial to insure that the tremendous amount of detail invested in the building interior wouldn’t be obliterated by the blast – the audience would be able to see all of our work.”

The three-hundred-pound Flatiron miniature was deemed so authentic-looking that footage of it was used to replace the actual building in several pre-destruction live-action shots. The bottom third of the model – which was set atop a five-foot steel deck – consisted principally of rigid resin castings mounted over a steel frame to provide a solid base. “The top two-thirds of the building were constructed entirely of breakaway material,” said Gratzner. “We provided two takes’ worth of pieces, though they got it on take one. We put in sub-floors and wall joints, then added twenty-fourth-scale desks, tables and chairs and lots of plumbing with toilets. We had to prescore all sorts of tiny little bits to make sure there wouldn’t be some foot-square scale-busting piece flying off.” To engineer the breakaway, a steel mechanism with three triple-jointed weak-kneed legs was used to hold up the roof. Steel cables connected the mechanism to air cylinders below. The cylinders – resembling pistons on a train – actuated a trolley-mounted plunger which forcefully yanked the top of the building downward.



Pursued by the tanks and aircraft Godzilla leaps into the Hudson River. SPI composited the CFX Godzilla into the background plate, which featured the expansive West Side Highway miniature and a live water element.



Able to reproduce asexually, Godzilla finds a suitable nesting site inside Madison Square Garden. A partially

The distinctive Chrysler Building would also draw a missile; and HGI built the entire top third of the structure and several domes for the effect.

“Production planned for two takes of the initial dome hit and another two of its falling into the street,” Gratzner explained. “We had photographic references, but they were all either helicopter views

or taken from street level – there was nothing dead-on.” The inconsistent appearance of the real-life Chrysler Building proved to be yet another complication. “The real Chrysler dome has a kind of nickel stainless-steel sheeting, beneath which is a supporting array of girders. The dome sometimes looks flat-gray, but there are other times when it shines almost like polished chrome. To match this we laid a coat of silver auto paint, then steel gray. We followed up with a heavy wash of thinned-out raw umber, then finished with heavy dry-brushings of chrome. This combination gave us depth and really captured the dome.” Breakaway plaster was used for masonry sections, while a combination of brittle resin, black-wrap and aluminum strips made up the facade, allowing for a realistic mimicking of metal being shredded and torn. Nights of Neon made custom neon textures to illuminate the Chrysler dome’s windows.

The top of the building takes a hit, causing the dome to topple earthward. “For this drop, the dome was air-actuated,” remarked Gratzner. “We deliberately designed it as a wholly mechanical move so that regardless of how the pyro went, the dome would follow its choreographed motions. When the face of the building was blown off, an air cylinder dropped the dome down about a foot. Then another cylinder connected to a catapult arm flung the dome, which was set on rails, toward camera.” In a separate twenty-fourth-scale setup, the dome crashes to the street. HGI constructed store fronts that were mounted to the rental buildings for the scene, while the street, sidewalk and street dressing were provided by Mike Joyce and his Cinema Production Services. Verisimilitude was achieved via highspeed shooting – at frame rates between 270 and 360 frames per second – and the use of aluminum strips inside the plaster cast dome, which allowed the dome to retain structural resemblance to its undamaged self, even after impact.

“The aftermath shot,” remarked Engel, “featured live-action soldiers waving flashlights around as they inspect the crashed dome. There are fires burning – but except for the live-action and these sweetening elements, the entire image is essentially just this in-camera miniature. I was very pleased with the results.” The military presence in city streets required miniature duplicates of many epic-size location setups. Even as Clay Pinney was bringing tank cannons to life on location, Joe Viskocil was arming Cinnabar’s sixth-scale replicas for the miniature shoot. “The tanks had articulated, recoiling steel-lined cannon barrels, which accommodated Joe’s pyrotechnic charges. They featured working suspension systems, as well, allowing us to manually pull them down and backward when the guns went off. We shot greenscreen sometimes; but the pyro did not key well, so the rockets were reshot against black.”

The tanks are scattered like toys by the enraged Godzilla. “Each tank weighed about 150 pounds,” noted Gene Rizzardi, “so they hit pretty hard when Joe Viskocil flipped them. We also had to reproduce them in twenty-fourth scale in just two weeks. We delivered, thinking they were going to

wrecked stadium interior – built in twenty-fourth scale by the matched Babyzillas hungrily explore their surroundings. Character animation was provided by dressing by Tony Ciccarelli prior to filming. VisionArt and CFX, while compositing duties were divided between those two companies, plus Digiscope and SPI. For more expansive scenes – some featuring hundreds of babies – VisionArt used proprietary tracking software and flocking programs.

be sitting off in the distance; but instead, the camera was only four inches away. Fortunately, they held up on film.”

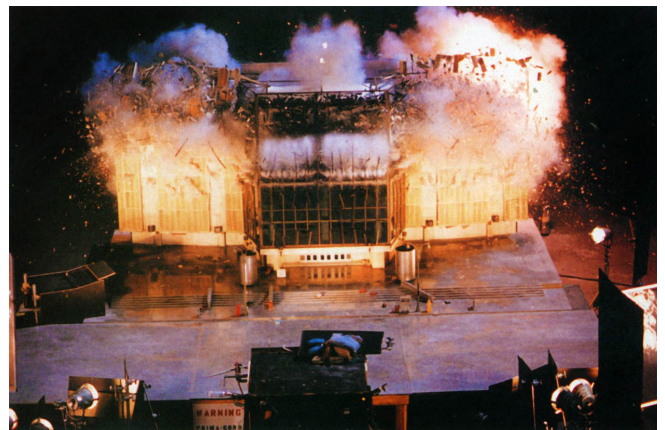
Godzilla has more than size on his side as he defends himself against the assault – he also has his trademark fiery breath, dubbed ‘power breath’ by Centropolis staffers. The concept of fire-breathing provoked considerable debate amongst all concerned. “Dean and Roland wanted this monster to retain a certain menace and credibility,” said Engel, “but Godzilla’s breath is something everyone expects to see at some point. So they came up with instances in which you would see something like the old breath, but with a kind of logic applied to it. We make the assumption that something in his breath, when it comes in contact with flame, causes combustive ignition. So you get this flame-thrower effect, which causes everything to ignite.” At one point, pursued by several Humvees – built by Larry Jolly – *Godzilla* turns and blows on them, sending them flying. “A wall of fire comes toward the Humvees and wipes them out.”

For those shots, Sony Imageworks combined Joe Viskocil’s pyrotechnic elements and greenscreen model Humvees with a live-action street plate. SPI also developed a heat ripple breath effect emanating from *Godzilla*’s mouth. The ripple was a combination of CG particle and 2-D displacement effects, finessed in digital compositing. The Imageworks crew also added interactive lighting on the CG *Godzilla* during the color and lighting stage to tie in the wall of fire.

Godzilla goes to ground, tunneling deep into the island and utilizing the subway system to locate a suitable nesting place. An enormous full-size subway station set, designed by Oliver Scholl and constructed on stage, had to be duplicated in miniature for the creature’s breakthrough. “There was a model for the 23rd Street tunnel,” said Engel, “within which *Godzilla* has burrowed. He uses the existing subway tunnels and enlarges them to accommodate his considerable bulk. We started with a twenty-fourth-scale man-in-suit creature and tunnel, but soon discovered that the creature looked too human at that size – the writhing, crawling movements never seemed quite right, because of the limitations of a human being’s spine. Also, the tunnel itself was so tiny that we were experiencing depth-of-field problems. So Cinnabar built us a sixth-scale tunnel that came apart in sections so we could shoot it in whatever configuration might be needed. We then reshot the clean plates of the tunnel. Back at Centropolis, Matthew Hackett



To eliminate the threat posed by hundreds of Godzilla offspring, fighter aircraft are called in to destroy Madison Square Garden with missile fire. Shot as a night exterior in Playa Vista, the scene required the construction of a twenty-fourth-scale miniature by Cinema Production Services, with model cars and adjacent building facades to fill out the frame.



Shot high-speed, the Madison Square Garden explosion was engineered by Joe Viskocil, who rigged the breakaway miniature with pyrotechnics to simulate the missile impacts and subsequent concussive blast. The attacking

animated a fully CG *Godzilla* to crawl and claw his way through the tunnel. Imageworks then added CG debris, and lit, rendered and composited *Godzilla* into the plate. For a shot in which *Godzilla* breaks through one of the tunnel walls, we painted a big piece of metal with greenscreen colors and used it as a stand-in for the CG creature, ramming it through the well-prepped tunnel side wall using a dolly on tracks.” Anna Foerster lit the sixth-scale tunnels to match the very dark live-action sets, yet still show all the detail and hold the depth of field while shooting at high frame rates.

jet aircraft – recycled CG F-18 models first developed for Independence Day – were animated by VisionArt.

Pursued once more, *Godzilla* finds himself bombarded from above by attack helicopters. “We needed a lot of background plates for the big helicopter chase,” related Engel. “Don Baker supervised a motion control unit that shot POVs and pan/tilts for flybys using our various building models. These chase and flyby shots turned out to be element-intensive since we had to add foreground cockpits featuring rain and reflections, as well as occasional glimpses of the other helicopters in the chase – which, with the exception of an eighth-scale crash miniature, were all CG models from Imageworks.”

Imageworks animated and composited their CG helicopters into the plate backgrounds, first modifying the gun mounts on their digital model to match those on the production’s Apache attack helicopter. “Roland wanted total mayhem for the helicopter chase scenes,” recalled Jerome Chen. “The CG Apaches ranged in number from three to thirty, depending on the shot. All of them had to be choreographed with CFX’s animation of *Godzilla* running through the buildings; and our own animators had some fun bobbing and weaving the Apaches behind him, maneuvering for a clear shot.” CG tracer fire and building impacts were created at Imageworks to heighten the destruction caused by the military in its efforts to destroy the beast. “We modified the street foot-impact technique to create the illusion of tracer fire riddling the facades of the miniatures. Then CG particle debris and smoke were added to round out the effect of the Apache cannon fire strafing the buildings all around *Godzilla* as he runs.” In addition to lighting *Godzilla* in this environment, the SPI crew developed RenderMan shaders for the wet look of the gunships, along with particle rain and lighting effects on the gunship searchlight beams.

The Acton tank was again employed – this time for water impacts and pyrotechnic work – as the beleaguered *Godzilla* escapes, at least momentarily, by leaping into the Hudson River. “A hunk of metal shaped roughly in the form of the creature was plunged into the water,” Engel said. “Andy Jones matched *Godzilla*’s move to the impact of our metal shape.” In the compositing stage, Imageworks used the main splash element, layering in additional water impacts to accentuate the scale of the splash created by the giant creature.

Chased by three submarines, *Godzilla* endeavors to burrow back into the shoreline. VisionArt supplied water, submarine, bubble and torpedo elements, along with schools of fish – created via flocking software – that scatter at the creature’s approach. The pursuing subs were realized by modifying a model from Viewpoint DataLabs. Centropolis supplied the underwater *Godzilla* animation, and Digiscope composited all of the elements. To build on that imagery, Volker Engel arranged for Cinnabar to construct a fifty-by-thirty-foot underwater shoreline, complete with rusting cars and bridge pylons. Absent from the model – which was shot on a smoked stage – was

the silt cloud formed by *Godzilla*'s burrowing. Gene Warren filmed the requisite element in his new tank at Fantasy II.

Two torpedoes enter the silt cloud and detonate before the creature can tunnel to safety. Motionless, and seemingly dead, *Godzilla* sinks into the murky depths. The underwater blasts climaxing the submarine attack on *Godzilla* had first been attempted in CG, before being redone practically in the Fantasy II tank. With *Godzilla* presumed dead, the focus turns to his nest, located within *Madison Square Garden*. Nick, accompanied by Philippe Roaché (Jean Reno), investigates the lair, discovering hordes of *Godzilla* hatchlings. Patrick Tatopoulos designed the look of the babies early on; and his shop had built a suit, pieces of which were sent to CFX for scanning and color reference. Tatopoulos' crew also built a hydraulically operated baby on a motion base, plus nine self-contained units, worn by performers in suits, which had radio-controlled heads. Ultimately, the decision was made to realize all of the walking, running and leaping babies through digital techniques, with the remaining baby shots split between suits and CG.

Character animation for the babies was handled by VisionArt animators David Kramer and Carl Hooper, and by Matt Hackett at CFX. "If Andy Jones was *Godzilla*," commented Karen Goulekas, "then Matt Hackett was *Babyzilla*. He hit upon a style for the hero baby, developing running cycles while also figuring out how the babies would bite and chew. The rest of the team locked onto that and followed suit."

It had taken six months to set up a pipeline for the *Godzilla* animation, but Centropolis and VisionArt were able to reset for the *Babyzillas* in only six weeks. "VisionArt began setting up a key-frame group using Softimage," said Goulekas, "but in the meantime, we wanted to use the lighting and rendering pipeline they already had set up. Their *Babyzilla* model – for which Viewpoint had done medium and high-rez polygonal models – was already fully textured for Prisms. With no time to create a NURBS baby model, Steffen Wild imported the texture-mapped polygonal data from VisionArt into Softimage. He then took his inverse kinematics *Godzilla* skeleton and revamped it for the babies so that CFX could start animating them in Softimage. That left us with the problem of lighting and rendering. John Lewis wrote a program that took the Softimage scene files and downloaded the polygonal information frame by frame. It was a slow process, but it permitted VisionArt to import the polygonal shapes back into Prisms for lighting and rendering."

Though *Babyzilla* compositing was divided among VisionArt, Imageworks, Centropolis and Digiscope, VisionArt handled all of the lighting and rendering chores for the sequence's approximately one thousand separate babies. "We did flocking shots featuring more than 150 of these things," said Josh Rose, "so additional lighting complexities arose from all of the shadows being cast. We called them B.O.B. shadows – 'baby on baby.'" VisionArt's 3-D tracking software obviated the need for on-set measurements. "It was great to be able to use our software on such a huge variety of shots, as this show gave tracking a thorough workout. We refined our existing flocking programs, essentially putting them on steroids to accomplish the work."

Nick and Philippe are right behind a door when a baby slams against the other side. "We made up a steel piece in the shape of a baby head," Clay Pinney commented, "then we rammed it against a lead door, which took an impression of the head. Oliver Scholl and I worked out another bit of business when the heroes are trying to slow the babies up enough to make their escape. Philippe shoots at

three giant chandeliers – each one containing five separate glass rings, the largest six feet in diameter – which we equipped with neon and rigged to fall from a height of thirty feet.”

In addition to the twenty-fourth-scale *Madison Square Garden* interior, Cinema Production Services built a same-scaled exterior for a scene in which the famed arena is struck by air-launched missiles. Gene Rizzardi dressed the exterior set with a number of twenty-fourth-scale vehicles and a few eighteen-foot-tall facades to represent adjacent buildings. The destruction of *Madison Square Garden* was achieved by Joe Viskocil – who modestly summed it up as just another White House explosion’ – while attacking aircraft were revived from *Independence Day*. “We only had a few jet aircraft scenes,” explained Engel, “so there was no need to go with stage models. Vision Art was able to reuse the CG F-18s from *Independence Day* for this production. There were new flight paths, so it was not as though we could actually use the old elements; but the CG models were the same.”



A vengeful Godzilla stoops to snap at Nick and friends as they flee in a speeding taxicab. New York street footage was augmented with plates shot in Los Angeles and studio process interiors. SPI employed extensive tracking, rotoscoping and paint work to effectively place Godzilla on the ground plane and behind foreground objects in the live-action photography.



The Sightline Productions crew prepares to shoot a taxicab POV as Godzilla thrusts his head up through the roadbed of the Brooklyn Bridge. The scene utilized Tatopoulos' twenty-fourth-scale Godzilla head and a fifty-foot-long bridge miniature fashioned by Cinnabar.

A not-so-dead *Godzilla*, presumably drawn by the hatching of his offspring, emerges from the ruins of *Madison Square Garden*-very angry. The twenty-fourth-scale suit was again used in conjunction with high-speed photography. “Kurt Carley, our man-in-suit *Godzilla*, stood on a little staircase of apple boxes so he could thrust himself up while the RC guys operated the mouth and eyes,” stated Engel. While this initial breakthrough featured the performance suit, the speed at which Carley could move – especially when being filmed at up to 200 frames per second – lacked the necessary urgency, so follow-up shots of *Godzilla* rising featured the CG creature.

Godzilla then pursues Nick and company into a very narrow alleyway. “*Godzilla* can’t possibly fit inside this alley,” stated Engel, “but that doesn’t stop him from trying. The principals are in the foreground, this enormous wall of destruction on both sides gaining on them, as *Godzilla* tears through the obstructing buildings on each side of the alley. We tested it with the twenty-fourth-scale suit, but whenever the guy hit a building with his shoulder he would rebound a bit – it just couldn’t be helped.” A more rugged version of *Godzilla* was provided by Viskocil crew members Mick Duff and Joe Heffernan, who built an elaborate steel rig that simulated the creature’s shoulders. Mounted on a rolling sled, the ram was propelled toward camera at a thirty-five-degree angle, smashing through miniature buildings as it progressed down the street. Since the device conformed roughly to the creature’s contours, the destruction it left in its wake facilitated the eventual replacement of the rig with the CG *Godzilla*.

Nick and his companions flee the creature in a taxicab. The scene combined drive-bys – filmed in Los Angeles – with studio process interiors. Stunt personnel stood in for the principals during segments of the exterior shoot calling for dramatic cab lurches in response to *Godzilla*’s proximity. Stunt coordinator R.A. Rondell utilized twelve-inch jump ramps on the cab to create the jolting action, while, for closeups of the stars on a rear projection stage, Clay Pinney devised a rig to duplicate the effect. “Four pneumatic cylinders mounted on A-arms allowed the car mockup to jolt in any direction. We could jump the car eighteen inches at the touch of a button. It was a big E-ticket ride.” Street shooting from inside the moving taxi required a mobile supply of rain. “There was nowhere to hide rain towers, since you could see ahead for several blocks through the windshield. To the back of the cab we attached a trailer that held a 220-gallon tank and a pump that was operated via remote control. Then we mounted a big rain bar that extended forward to shoot the water out in front of this traveling rig. Since the cab was moving at thirty-five miles per hour, it would run into the rain, maintaining a constant atmospheric element no matter how long the shot ran.”



Anna Foerster and first assistant cameraman Jeff Sturgill shoot the head after *Godzilla* has snared the taxi and a slab of pavement between his jaws. Additional shots were realized by Clay Pinney and crew using a full-size jaw and cab mounted on a four-way gimbal.

The taxicab races into a Park Avenue tunnel that turns out to be closed for reconstruction, triggering a wild doubling back to slip past the pursuing *Godzilla*. The tunnel was yet another sixth-scale model, used in conjunction with a remote control taxi created by Stirber Visual Network. Operating the cab was Gene Rizzardi, who handled all of the remote driving. “John Stirber delivered a nice sixth-scale taxicab,” Rizzardi related, “which later needed to be souped-up for high-speed shooting. We got word about this change in dailies one morning, then managed to install a new motor, new speed controller, and even a gyro to help steer it in time for them to start shooting that same night. Remote-operating the model cab on wetted-down roadways was like driving on ice skates. It wasn’t until we were nearly finished that someone hit on the idea of using spray glue on the hard cab wheels.”

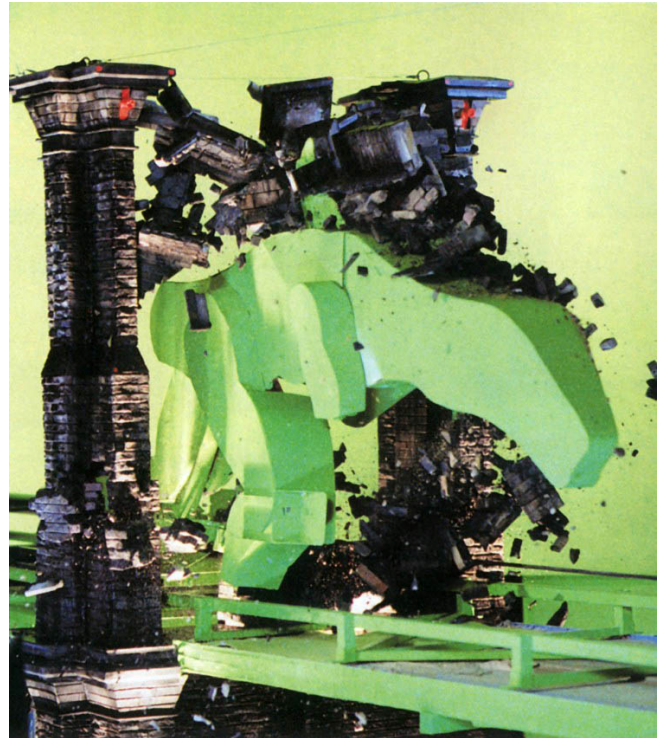
As those inside the taxi begin to breathe easier, in the belief that they have eluded *Godzilla*, the behemoth suddenly rises up through the Brooklyn Bridge roadway in front of them. The braking cab skids into the creature’s open jaws, and only a mouth-filling slab of pavement beneath the vehicle keeps him from biting entirely through it. After the car escapes, *Godzilla* pursues it across the length of the bridge, only to be snarled on suspension cables and vanquished by missiles. Because of the complexity of the Brooklyn Bridge shots, Karen Goulekas insisted upon a full previsualization of the sequence. The initial plan involved using the twenty-fourth-scale suited performer on a fifty-foot bridge miniature – though the sixth-scale *Godzilla* torso and a like-scaled section of bridge would also be required. “We removed two of the main bridge cables to allow the creature enough room to move around,” explained Engel, “figuring the girderworks would camouflage our remodeling. But then we found out Roland wanted this suspension bridge to be ‘flexible’ – actually rippling, then shaking up and down as *Godzilla* stomped down the length of it. At that point, we turned away from doing all of it as a stage miniature, though some shots in the sequence do utilize the models. The bridge breakthrough was all sixth-scale, except for a cab POV shot on the twenty-fourth-scale bridge. Then there’s a lot of cutting back and forth to the shoot on Sony stages of the cab on a gimbal inside *Godzilla*’s mouth.”

While all concerned had hoped to avoid having to articulate a full-scale mouth, this proved to be unavoidable. “It became clear to everyone that we’d need to see at least part of the upper row of *Godzilla*’s teeth to sell what was going on,” recalled Clay Pinney. “We carved out a full-scale jaw, which we then mounted on top of a cab crusher. Those rigs then went atop our four-way gimbal.” A large translight of the New York skyline was erected in a curve around the gimbaled set, establishing a wide panorama that could be glimpsed during the fevered jerking movements of the creature’s head.

Nick shoves a live electrical wire into *Godzilla*’s mouth, making him scream and pivot around so that he is facing the other way on the bridge – thus permitting the cab to drive out of his mouth and continue its escape. Viewpoint modeler Steve Keele was on site during the shoot. “I was there for about six weeks, principally to build a piece of digital bridge that *Godzilla* takes into his mouth along with the taxi.” Using the twenty-fourth-scale bridge model as reference, Keele also served as project lead for the digital taxicab, electing to match to that miniature instead of its full-size counterpart. “I went in with the intention of digitizing a real cab – we’ve done plenty of life-size vehicles, so that wouldn’t have been anything new – but when we saw how much of the sequence used the RC miniature, we decided to digitize that instead.”

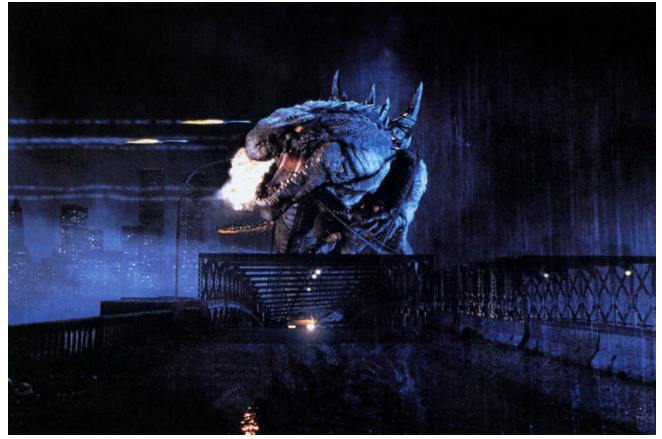


After escaping from the creature's maw, the taxicab races across the Brooklyn Bridge with Godzilla in close pursuit.



To capture a highspeed shot of the beast ramming through a bridge tower, the Sightline team employed a green-painted steel Godzilla facsimile mounted on rails. The rough approximation of the beast was then digitally extracted from the frame and replaced with key-frame animation.

The remainder of the revised bridge chase retained only the miniature towers as stage elements, with the rest of the bridge becoming a digital melange. “One of the biggest challenges in that sequence,” recalled CFX compositing supervisor Cornelia Fauser-Ruemelin, “was that, for most shots, all the elements – *Godzilla*, bridge, cables, water, et cetera – were synthetic, except for a little fog and rain. That meant our compositing team, led by senior compositor Nelson Sepulveda, had to design the look for the sequence entirely in the computer.”



Ensnared by bridge cables, Godzilla falls victim to a missile attack from fighter aircraft. Rather than hand-animate the effect of CG cables pressing against the digital Godzilla, an animation plug-in was developed to create organic-looking deformations in the creature's body.

Godzilla nearly catches the cab before ramming into a second tower, which slows his advance. Based on CG previzualizations, a twenty-fourth-scale green-painted steel *Godzilla* was erected in a crouched pose and set on rails for the tower ramming. The tower breakthroughs accomplished with miniatures looked convincing; but getting them to work in conjunction with the CG *Godzilla* was problematic. “The maquette used for the breakthrough was close to being in the right pose,” stated Mitchell Drain, “but it wasn’t all the way there. So we wound up having to do a lot of morphing on the falling debris to get these flight paths to match the contours of the CG creature.”

As the bridge tower collapses, *Godzilla* is netted and pinned by suspension cabling. “With each step *Godzilla* took,” related Karen Goulekas, “the dynamics changed. Complex math functions were required to describe the degree to which the CG bridge would rock on impact of his foot, or the amount of tension in the cables. Then it took an enormous Softimage plug-in to get those cables to creep across his body and seem to hold him without intersecting the creature’s actual geometry.”

Created by Maria Lando and Joe Alter, the requisite plug-in provided amazingly organic-looking deformations. “When the creature pushes against the cables,” stated Alter, “they move dynamically, with real tensile strength. When he presses really hard, they snap and fly around. The original plug-in didn’t have the necessary dynamics; and for a while it looked as though the thousands of bridge cables would have to be animated by hand, which would have taken forever. I went back to some dynamics code I had started to write for *Cliffhanger*, then wrote a new inverse kinematics model that handled any number of constraints. The creature could push against the cable at various points, with his weight and strength represented at different intensities.”

Jet fighters fire their missiles, mortally wounding *Godzilla*. The beast’s nearly dead weight begins to pull the bridge apart, and the cables rip loose from their stanchions. With the road falling away beneath it, the taxi arcs through space, only just making the other side as the bridge collapses. To get the flying car shot, the souped-up sixth-scale vehicle created by Stirber was remote-controlled to race up a ramp. “At the point when the bridge drops away,” said Rizzardi, “the car really went airborne – six or seven feet in the air. When it finally came back down, it landed right smack on the mooring, hitting on all four wheels. So we got it on take one.”

The sixth-scale Tatopoulos-built *Godzilla* torso was used for an extreme closeup of the beast – featuring a nictitating membrane over the eyes – in his final death throes. “Gino Acevedo came up with a look for the eyes,” stated Tatopoulos. “I wanted a kind of light behind them that would serve to intensify the beast’s gaze. We went with this light core within a dark outer eye, which draws your attention – like there’s a flame inside. There was a dimmer that allowed us to dial it up and down, so we could subtly fade the light out as *Godzilla* died.”

The film’s conclusion hints at the prospect of at least one surviving *Babyzilla*, fairly promising sequels. “Unlike *Independence Day*, which wasn’t designed with follow-ups in mind,” commented Dean Devlin, “we developed *Godzilla* with the idea of doing another couple of stories that explore matters more deeply and take the myth further. Of course, anything like that happening is entirely dependent on audience response.”

With the more-than-modest success, both domestically and abroad, of *Gamera the Guardian of the Universe* – a revived franchise from Toho competitor Daiei – the ‘kaija eiga’ (Japanese monster movie) has entered a new stage in its evolution. Current efforts now feature CGI and higher budgets – though Toho must make do without its biggest star, or his creator. Toho’s *Godzilla* died in 1995 – in *Godzilla vs. Destroyer* – consumed by the very nuclear radiation which brought him forth; though in so doing, he caused his dead son to revive and mutate, presumably to fill his parent’s claw prints. Then, in April 1997, Tomoyuki Tanaka died as well. “With this movie,” Devlin reflected, “Roland and I wanted to get back to what Tanaka was thinking about as he flew over the Bikini Islands and hit on the idea of this monster. What did he want the audience to feel when they came to experience *Godzilla* for the first time? The original film had a genuine impact on moviegoers – and forty-four years later, we’re trying to recapture that.”

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HIDE IT IN SHADOW, HIDE IT IN LIGHT

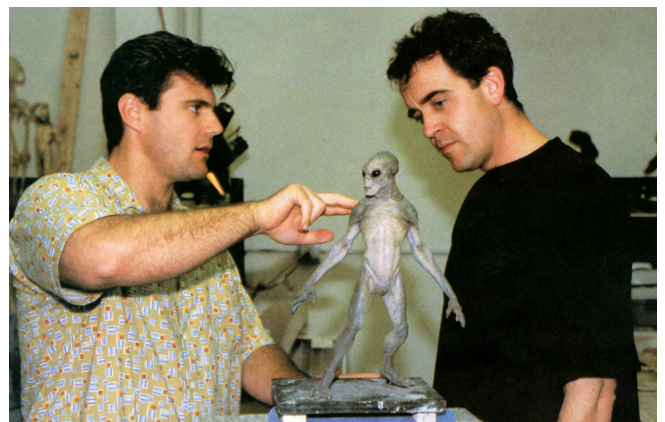
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ARTICLE BY
JODY DUNCAN

As far as Chris Carter was concerned, he had been making movies all along. Forty-three-minute ones. Two dozen of them a year for five years.

From the moment *The X-Files* premiered in September 1993, its creator had prevailed over television's small budgets and eight-day production schedules, producing hourly dramas that boasted expansive themes, lavish production values and rich, stylish cinematography. It was only in the area of visual effects that the show had been forced to bow to the restrictions of episodic television; and, even there, Carter's high standards had prevented him from settling for effects that looked cheap or substandard. Instead, the production team had opted to show very little in terms of effects, and to rely on the collective imaginations of the audience. The show's visual effects philosophy – 'hide it in shadow, hide it in light' – would serve the series well through all five of its seasons. But with the release of a feature film this summer, *The X-Files* was finally given the chance to strut its supernatural stuff in grand cinematic style.

Given the intensity of the show's following and the penchant of movie studios for mining television for feature production, there was little surprise when rumors began flying about a full-length version of *The X-Files* to be produced by Twentieth Century Fox and Carter's own Ten Thirteen Productions. Directed by Rob Bowman – an X-Files veteran who had



The five-season run of The X-Files culminated with the release of the first feature film based on the popular TV series. The movie would provide some resolution to an ongoing storyline regarding a government conspiracy to cover up evidence of an alien presence on earth. Hired to design and realize the alien were Alec Gillis and Tom Woodruff of Amalgamated Dynamics Incorporated. Gillis and Woodruff examine an alien maquette.



Among the X-Files veterans who stepped up to bring the television show to the big screen were director Rob Bowman, who had helmed two dozen episodes of the

helmed two dozen episodes – and produced by Carter and Emmy-winning television producer/director Dan Sackheim, production commenced in June 1997, during the hiatus between the show's fourth and fifth seasons, continuing well into

series, and visual effects supervisor Mat Beck, who had overseen the show's effects during its first three seasons. Bowman and Beck discuss an upcoming shot at the Los Angeles Arboretum.

October. Remaining months of that winter and spring were devoted to finalizing the movie and completing its roster of 200-plus visual effects shots in time for an early summer opening.

Orchestrating that effort were visual effects supervisor Mat Beck, who had overseen the effects for the television show's first three seasons, and visual effects producer Kurt Williams. Beck had just come off a grueling year-long shoot for *Volcano*; and Williams had been similarly occupied, running the miniatures unit for *Batman & Robin*. But, tired as they were, both men jumped at the chance to work on *The X-Files*. "Mat already had a relationship with everyone involved with *The X-Files*," Williams observed, "and I was a very big fan of the show. More than other movies that have been made from television shows, I wanted to be a part of this one. I also knew of Mat, and was interested in working with him. So we both got on the movie and immediately threw together the first visual effects package, which was about sixty-four shots. Eventually, it evolved to about 215 shots." In addition to his own effects company, Light Matters/Pixel Envy – which would be responsible, primarily, for digital set extensions – Beck sought the involvement of *Blue Sky*|VIFX, which took on two important effects sequences, plus Hunter/Gratzner Industries, which was responsible for building a crucial model for the film. Ian O'Connor, who executed miniature pyrotechnics, and Robert Spurlock, who acted as model photography consultant, were other key members of the visual effects team. Creature and makeup effects assignments went to Amalgamated Dynamics Incorporated and to KNB EFX Group, while Paul Lombardi's Hollywood Special Effects contributed wind and dust, large-scale explosions, burning cornfields and crucial mechanical units featured within a spaceship interior. Hollywood Digital was brought on in postproduction, specifically to add breath vapor shots that would sell the frigidity of that spaceship environment.

Even with the work divided among seven facilities and freelance personnel, *The X-Files* was a huge undertaking, executed under less-than-ideal circumstances. The series' production schedule and lengthy contractual negotiations with the studio led to film production being launched after a mere ten weeks of preparation. As a result, the filmmakers were behind before they ever started, and the entire production effort became an anxious game of catch-up. But through tremendous effort and dedication, catch up they did; and what ultimately wound up on the screen was a polished, well-executed film.

Written by Chris Carter, from a story created by Carter and Frank Spotnitz, the show's co-executive producer, *The X-Files* opens on a vast frozen landscape, where two primitive men follow strange, three-toed tracks in the snow. The time is 35,000 B.C., and the place is an area that will one day be known as Texas. The scene was filmed on location at the Pemberton Ice Cap, a glacier situated two hours north of Vancouver, British Columbia. There, prosthetic makeups designed and fabricated by A.I. were applied to actors Carrick O'Quinn and Craig Davis by veteran makeup artist Lance Anderson and a small crew. The makeups consisted of three pieces each – one that simulated a strong, Neanderthal-like chin, a second to create a wide nose, prominent brow and high

cheekbones, and a third for the top of the head and ears. Yellowed teeth veneers were also worn by the actors, along with hand-punched facial hair pieces and dark brown contact lenses.

The three-toed tracks eventually lead the primitives to an ice cave. Scenes within the cave were shot on a set built on a refrigerated stage at Fox, dressed with fiberglass 'ice' walls and real chipped ice. Wider cave interiors were captured within real ice caves on the Pemberton glacier by a second unit crew. Inside the cave, the hunters meet their prey – a tall, powerful, hairless alien with large black eyes. The alien was designed, built and performed by A.I, and represented that company's most important contribution to the movie. Since the creature would be featured in both the primitive opening and modern-day scenes, A.I designed two versions – one appearing more fully evolved than the other. To save time, only one version of the body was sculpted and fabricated; and most of the differences between the primitive and modern alien were incorporated in the heads and through contrasting paint jobs.

A.I artists Jordu Schell, Andy Schoneberg and David Perteet first produced a series of sketches of the alien. Once a design had been approved by Carter, Sackheim and Bowman, those sketches were then translated into three dimensions through a fifteen-inch-tall maquette, constructed by Schell. Since the role would be performed by A.I co-founder Tom Woodruff, the alien was first sculpted over a lifecast of Woodruff's own body – cut down slightly to ensure the suit would be as tight-fitting as possible. Foam latex pieces were run and attached to a Lycra bodysuit for additional support. The final suit was the tightest Woodruff had ever donned for creature work. A full ten minutes was required just to work the costume over his hips – a process eased by sprinkling talcum powder on the inside. The suit was closed with a zipper in the back; then a cowl piece that served as a mantle for the head was glued down. Separate gloves and foot pieces served as the creature's extremities.



The alien was brought to life through a combination of animatronic heads and a full body suit worn by Tom Woodruff. A.I mechanical designer John Lundberg at work on the alien underskull.

Heads for both the primitive and modern alien were sculpted separately by Steve Koch and Jordy Schell and included a stunt version and a hero version for each. The hero heads were fitted with radio control mechanisms – designed by John Lundberg – for articulation of the eyes, lips, cheeks and brows, and were operated by three puppeteers on joystick controllers. The number of mechanisms that had to be fit within a five-inch space of the skull left no room for a window or small video screen, leaving Woodruff essentially blind within the apparatus and completely reliant on guidance from his off-camera crew. Later in the schedule, when Bowman filmed the creature in darker environments, the crew removed one of the black resin eyes – since it would never be seen in those lighting conditions anyway – which afforded Woodruff some visibility. The simpler stunt head had cable-controlled articulation and could be manipulated to lower its brows and open its jaws. Sculpted in a fierce attack expression to begin with, the stunt head had a double-hinged jaw that enabled the puppeteers to open its mouth much wider than the hero head was capable of doing.

The combat within the cave ends with the death of the alien and one of the primitives. The surviving primitive becomes the victim of an even worse fate, however, when the alien's black oily blood begins to creep up the man's body, infecting him with a virus that, left unchecked, will eventually gestate into a full-grown alien. The black viscous carrier of the virus had become a familiar threat within the narrative of *The X-Files*. For the TV series, the effect had been accomplished digitally – but in a fairly quick-and-dirty fashion, due to limited time. With the relatively leisurely schedule afforded the feature film, a more sophisticated digital approach was employed.

On the ice cave set, Mat Beck shot motion control plates of the primitive. Since the dim lighting in the scene would make it extremely difficult for the digital team to see the tracking dots placed on the actor, Beck used an ingenious camera setup – custom built by Al Miller, with advice lent by Jon Erland – that entailed filming the actor at 48 frames per second, with LED lights rigged to flash every other frame. The result was twenty-four 'clean' frames per second, and twenty-four flashed frames, complete with illuminated tracking dots. The clean frames enabled Light Matters to track the movements of the actor, without having to remove the tracking marks digitally.

In postproduction, the Light Matters team added CG 'worms' to the footage, using a 3-D model similar to the one it had employed for its lava effects in *Volcano*. "It was basically a blob of brown that looked like a piece of flattened-out bread dough," said 3-D supervisor Colin Strause. Three digital shots were designated for the primitive sequence: a first shot in which a pool of blood oozing out of the creature stops and changes the direction of its flow; a second shot in which drops of



In an early scene, a young boy is infected with an alien virus via a black, viscous liquid that travels through his body subcutaneously. The 'worms' sequence was produced by Light Matters, which did CG replacement of areas of the boy's body so as to facilitate digital manipulation of his flesh. To create a composite effect of the boy's eyes filling with the black fluid, O'Connor Effects produced a practical element by injecting black ink into small tanks filled with water or oil.

blood on the primitive's chest begin to move; and a final shot in which the blood breaks up into smaller, wormlike organisms that move up the primitive's chest. "For the first two shots, we created an oily surface and hand-animated it to ooze out and turn back on itself. Then we used blobbie particles to break that up. I painted a map that faded the bobbies off into the surface so the transition wouldn't be apparent. The blood was so black, we could get away with little cheats like that. Since it was supposed to be like oil, we added a color noise map to create a rainbow effect and a bit of dust on top."

The camera moves from the stricken primitive man to the blackness of the cave ceiling – a blackness that is broken as a young boy, Stevie (Lucas Black), falls into the now-ancient grotto. A legend informs us that we are in modern-day Texas, in a suburb of Dallas. A group of boys digging in the desert has inadvertently uncovered an opening to the cave, where the alien virus has been lying dormant for the past 35,000 years. As Stevie recovers from his fall, the virus-rich oil moves toward the boy, into his shoe, and finally into the subcutaneous layer of his skin. To produce a slate of seven Stevie worm shots for the sequence, the digital team first commissioned a cyberscan of Lucas Black from Viewpoint DataLabs. That scan was loaded into the computer, then texture mapped with film footage of the boy. The result was CG replacement of the parts of his body that would have worms moving beneath the skin. "We had to hand-track the CG face and arm and leg replacements," noted Strause, "which was difficult because he was moving around a lot, shaking as if he was scared." The digital artists – including Strause and Francis Liu – subsequently rendered wiggling tube shapes, animated to move along a predetermined path on the CG body. "We'd load the 3-D arm in, for example, then go in with 3-D paint to make a path on the arm, determining where the worms would go. Once we had that path, we could render little white tubes that would follow the path we had painted. Then we rendered the same worms again, only twice as wide, and put them on there for a bruising pass. So wherever the worm was pushing out, blood and bruising was surrounding it and moving with it. It was a much more sophisticated effect than what they usually did on the show."

The challenge of surpassing what had been done for the television series was likewise taken up by Ian O'Connor of O'Connor Effects, who produced the elements for a trademark X-Files image – the oil pooling in the boy's eyes, making them black and sightless. "We built a couple of small tanks to get that effect," O'Connor said. "One gave us a vertical plane and another gave us the horizontal plane. Both tanks had white opal glass insert pieces so they could be backlit or, in the case of the horizontal tank, bottom-lit. Using syringes with teflon needles, we injected black acrylic ink into these tanks, which were filled with either water or an oil base." The tank elements were then composited into the live-action by Light Matters.

As the infection invades the boy's body, the camera pulls up in a long crane move from the mouth of the cave – a fourteen-foot-deep hole dug on location in the *Mojave Desert* – to a high establishing shot that shows Stevie's friends running for help and the Dallas skyline in the background. In a time transition, the crane moves back down to the ground, which is now littered with rescue trucks and personnel. The two camera crane moves were executed hours apart on location, without reliable reference points and in windy conditions – all of which made the tracking of the shot a time-consuming, often frustrating effort. "The crane was bouncing all over the place," Mat Beck recalled, "and the frame line was bouncing around like crazy. So we had to go in and smooth all of that out."

Since there were no tracking points, we just had to track to the geography that was actually there.” At Light Matters, digital supervisor Edson Williams was charged with tracking the shot and laying in the Dallas skyline, assembled from stock footage. “Edson really excelled at making it look as if Dallas was solidly in the background, instead of floating there.”

Among those to arrive on the desert rescue scene is Dr. Ben Bronschweig (Jeffrey DeMunn), a scientist working for a secret government entity. Bronschweig quickly takes control of the site, ordering the removal of Stevie’s body and the bodies of virus-afflicted firemen and setting up a testing facility within the cave. There he monitors the gestation of the alien virus within one of the firemen. Built by A.I, the ‘cave fireman’ was essentially a puppet within a puppet – an articulated alien embryo within the torso of an articulated human body. The fireman – mechanized by Evan Brainard through radio and cable controls – was made of nearly transparent silicone and contained an inner core painted by Mike Larrabee and Dan Brodzik to suggest veins and internal organs. Final touches included acrylic eyes and teeth, and real human hair punched into the skull. Situated inside that puppet was the embryo, sculpted by Jordy Schell and mechanized by John Lundberg. The embryo consisted of a foam latex skin and a radio control head with blink and jaw movement. Body movement was accomplished by manipulating rods that came out the back of the puppet. In a later scene, the now dead fireman is revealed, his torso area exploded outward as a result of the full-term alien’s eruption from his body. Although the birth itself would not be seen, its aftermath was represented by a second, nonarticulated body. For a scene in which Bronschweig is attacked by the full-grown alien in the cave, A.I fashioned a mauled makeup for DeMunn. The multiple-appliance makeup included underlying tubes that excreted blood when pumped from off camera.

Following the rescue scene at the cave, the movie cuts to a downtown Dallas government building where a legion of FBI personnel – including Fox Mulder (David Duchovny) and Dana Scully (Gillian Armstrong) – are in the process of responding to a bomb threat. When Mulder discovers the bomb within a vending machine, Scully initiates a frantic evacuation of the building as special agent-in-charge Darius Michaud (Terry O’Quinn) is summoned to disengage the bomb. But rather than deactivate the device, Michaud – apparently acting on secret orders – merely sits in front of the vending machine and watches as the bomb ticks down to detonation.

Each element of the vending room explosion was filmed separately. O’Quinn was shot against greenscreen; the vending machines were shot at Blue Sky|VIFX; and the explosion was shot as a miniature, again by the Blue Sky|VIFX crew. “Working in miniature,” observed Ian O’Connor, who engineered the pyrotechnics, “we could get something that looked like the core of an enormous explosion. To get that same effect in full scale, we would have had to do a very large, very violent explosion.” To ensure that the miniature pyro would interact appropriately with the Michaud greenscreen element, the effects team positioned a quarter-scale buck in front of the explosion. “In the greenscreen footage, Michaud is



Special agents Fox Mulder and Dana Scully are among the FBI personnel summoned to the scene of a bomb threat in a Dallas government building. When the bomb is discovered within a vending machine just minutes prior to detonation, special agent in charge Darius Michaud, on secret orders, merely sits and waits for countdown. Actor

seated and the camera is directly behind him. We took a clip from the greenscreen shot, created a template from that and used it to cut out a 3/16-inch-thick steel plate buck, which gave us a silhouette of the character seated there. The explosion would break around that form, giving us some interactivity.” The explosion itself was achieved with five mortars set up behind the form.

“The five mortars created an explosion that was not only aimed at the character, but would fan off to the sides. We adjusted the timing so that we could trip off the mortars in a certain sequence, all within a tenth of a second, to give the explosion a sense of expansion.” At Blue Sky|VFX, the miniature pyro was composited with the greenscreen element of Michaud and the element of the vending machines. “Since the vending machines weren’t shot with the explosion element,” related digital effects supervisor Derek Spears, “they had to be rotoed out as the explosion expanded, to make it look as if they were blasting apart.” The explosion element itself was also digitally time-warped, with the action accelerated, then decelerated to make it look like a much bigger explosive source.

The building explosion that follows was one of the biggest effects sequences of the show, requiring the expertise of both the physical and visual effects teams. On location in downtown Los Angeles – which stood in for Dallas – a glass and aluminum false front, two stories tall, was built onto the abandoned, sixteen-story Unocal building, then blown out by Paul Lombardi’s crew via primer cord and propane. Simultaneous with the explosion were effects gags such as cars lifted into the air hydraulically and desks launched out of upper story windows. To ensure thorough coverage, the explosion was captured with fourteen live-action cameras and three visual effects cameras, positioned on the roof of the Unocal building, the ground and – for a wide view – the rooftop of the ManuLife Insurance building that was situated a distance away.

As successful as the practical effect was, the filmmakers had known from the start that it would not suffice to sell the grand-scale explosion they had envisioned. At Light Matters, animatics were computer generated by Colin Strause as a means of designing miniature shots that would augment the live-action blast. In fact, these previzualizations were rendered before the practical explosion was filmed, to guide shooting of the live-action elements and ensure that those elements would marry appropriately with the model photography. “With that pre-viz,” remarked Kurt Williams, “Mat could go to the set and show Rob Bowman exactly what we were planning to do with our miniature – and that told Rob what he had to shoot.”

While the CG animatics had guided the filming of live-action plates, those plates themselves served as the primary reference by the time Beck and Williams brought on Hunter/Gratzner Industries, the company charged with constructing the building miniature. Ian Hunter had been the miniatures supervisor on *Batman & Robin* and had also worked with Williams on a number of commercials. “Initially,” recalled Hunter, “there was talk about building and blowing up a pyro model. But that wasn’t necessary for this sequence. Rather than blowing up a whole model – which would have required working in relatively large scale – we suggested doing a post-destruction sequence using a smaller scale model.”

Terry O’Quinn, the vending machine and the explosion were all shot separately, then artfully combined by Blue Sky|VFX. Views of the massive explosion rocking the building required both full-scale pyrotechnics – staged by special effects supervisor Paul Lombardi – and model photography achieved on a building miniature fabricated by Hunter/Gratzner Industries. Mat Beck and Blue Sky|VFX visual effects supervisor John Wash conducted the high-speed shoot, with pyrotechnics engineered by Ian O’Connor.

“We proposed that even with post-destruction, there should still be subsidiary action,” Matthew Gratzner elaborated. “The initial practical blast would blow out the front of the building. However, there would be other things happening immediately afterward – floors would collapse, debris would fall, furniture would tumble out. It wouldn’t just be a building with smoke coming off of it. There would still be a lot happening. Mat loved that idea.” After considering scales that ranged from sixth to twelfth scale, Hunter, Gratzner, Beck and John Wash at *Blue Sky|VIFX* – the company that would shoot the model and composite the sequence – agreed that an eighth-scale model was large enough to sell the post-destruction activity, yet small enough to be manageable and cost effective.

The visual effects team was initially assigned three shots for the building explosion: a rooftop down-angle that would reveal a giant fireball rising toward camera as the building facade fell away; a distant POV that would show the entire building and its surroundings in the immediate aftermath of the explosion; and a pan onto the destroyed building that would link up to a live-action pan on David Duchovny. “The sequence was so carefully thought out,” observed *Blue Sky|VIFX* visual effects producer Matt Ferro, “only a handful of shots were needed. Each of those images told a core part of the story.”

Before building the eighth-scale model – which translated to a structure twenty-seven feet tall and thirty-five feet wide – the HGI crew built a two-foot-square mockup made of foam core and plastic, penciling in the area that would be destroyed in the explosion. “We removed that area on the mockup and replaced it with collapsible floors,” Hunter explained. “Then we let Mat play with that mockup to determine lighting and camera angles. The idea was to, in a small scale, get everyone to agree as to what the nature of the destruction was going to be. We even indicated where we planned to have broken water mains or small fires.”

The mockup was then turned over to HGI construction chief Adam Lovell and his crew, which built a model that was fully three-dimensional only on the camera side as a means of keeping costs down. “Since we’d see only one side of it destroyed,” said Hunter, “all we needed on the other side was a facade with intact windows – although that side did have a full roof, which would be visible in the shot from across the street. We decided to build a facade, build the destroyed sections and build a roof, but mount them all to scaffolding that would be erected at the location. It was obviously easier to attach pieces to scaffolding than to build a self-supporting structure – especially for only three shots. There was no sense in going through a large construction process for something that was going to be on-screen so short a time.”

“This approach meant that we could build the model very quickly,” Gratzner elaborated. “From the time we sent guys to the Unocal building to photograph it to the time the model was erected at the shooting site was only six weeks.” The miniature was framed in steel, with facades and flooring built in stack-able, modular sections. “The sections ranged in size from four and a half to six feet tall, and each section was about half the length of the building. For the intact side, the walls were laser-cut from masonite by a company called Laser Custom Design up in Marin County. We could send them blueprints, sketches or CAD files, and they would turn around and send us pieces to assemble at our shop. The windows were also laser-cut – a separate frame and acrylic piece.”

The destroyed side of the model consisted of ten modular floor sections, each one hinged and rigged so that it would collapse on cue. “Those floor pieces were attached to large pneumatic

cylinders,” said Gratzner. “Air could be forced out of the cylinders, and the floors would collapse. The beauty of it was that we could fill them back up with air and the floors would be reset, ready for another take. We also piled up broken debris on them; so when the floors collapsed, things would fall down and tumble and hit the floors below.”

The interiors of the model were detailed with office furniture and other relics of a government office building. “We had a calendar in there that had Chris Carter’s birthday marked on it,” remarked Hunter. “There were clocks set to the time that the script said the explosion went off. Along the back wall were color xerox reproductions of doors and file cabinets; but the front edge of detail consisted of actual models – eighth-scale office furniture, chairs and desks. We had to build all of that, because eighth is a hard scale to find in off-the-shelf models. Since we didn’t have to get real nitpicky about the detail, we would take a simple desk model and cover it with a xerox of a blotter, or use a block of wood, with xeroxes of books on it, to represent a bookshelf. These dimensional shapes with photo reproductions on them looked like the real thing on film. We had different colored cloth that we ripped up and shredded and attached to floors to look like carpet. And since the bomb is in a vending machine, we took empty Coke and 7-Up cans from craft services, cut them up and bent them around pieces of tubing to make scaled soda cans. We stuck those in the mortars so that when the whole thing blew up, there were tiny Coke cans coming out. No one will see them, but they’re there.”



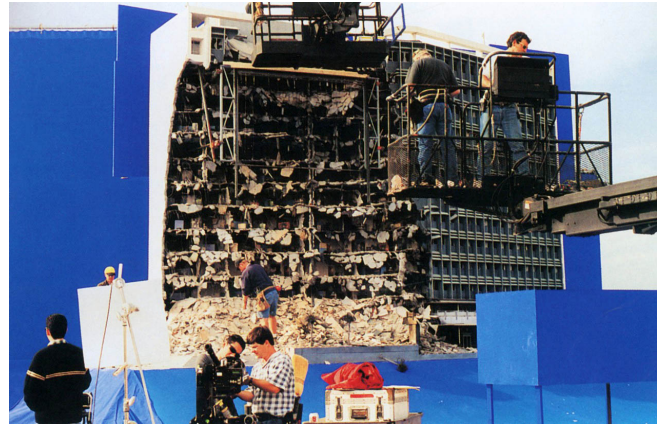
To illustrate the post-blast devastation, HGI first provided a small study model of the building, made of plastic and foamcore.

Other scaled detailing included miniature rebar, cable, sheet metal air conditioning ducts and I-beams jutting out from the ravaged building. Finally, floors were covered with scaled sheets of paper to represent the mountain of red tape associated with any government building. “We had an industrial paper cutter cut up four phone books for us, so there would be printing on the paper,” Gratzner explained.

In total, the company spent five days at the former Hughes Aircraft facility in Playa Vista, shooting the building model at camera speeds ranging from 96 to 120 frames per second. Set up on a four-foot-tall platform, the model was surrounded by bluescreen so that appropriate backgrounds and live-action footage could be matted into those areas. In the first shot of the sequence – a down-angle from the roof of the building – the facade of the structure slides down the front face as a fireball rushes up toward camera. A separate collapsing wall piece, made of laser-cut pieces of half-inch medium-density fiberboard, was built and positioned in front of the building model. Those pieces interlocked to form what looked like a ten-foot-square jigsaw puzzle, held together by a steel frame built by O’Connor Effects. O’Connor was also responsible for rigging the wall to collapse. “The trick was to build a rig that would give us control over each separate piece so that we could make them drop in an orchestrated manner,” explained O’Connor. “We had to be able to sync it with the timing of the fireball that would be rising at the same time. All of this had to work in sequence, in less than a second.” O’Connor and his crew fed nylon line through each separate piece of the wall; and attached to each nylon line was a pyro charge that would burn through the line and release that piece on cue. “The entire thing worked off a sequencer box and was wired so that the lines would cut in sequence, radiating out from a center point.”

Complicating the timing issue was the fact that each section of the wall had to collapse just as it was met by the rising fireball. O’Connor, Spurlock and the HGI team conducted numerous tests to work out the sequence of events in advance of the shoot date. To create an unusual fireball, O’Connor used a variety of pyrotechnic materials. “We had nine individual charges on the ground,” stated O’Connor, “each a combination of low-smoke flash powder, benzoyl peroxide, black powder and other things, to give us a mixture of smoke colors and other interesting characteristics. In the center was a propane mortar with a custom cone to create a wide, rounded fireball.”

Live-action footage of the street activity below was composited into the shot by Cesar Romero at *Blue Sky | VIFX*. “It was a fairly straightforward shot in terms of compositing,” said 2-D supervisor



Rather than build a self-supporting model, HGI opted for facades that could be attached to scaffolding at the shooting site. The erected model rose twenty-seven feet in the air and was surrounded by bluescreen to facilitate insertion of live-action elements.



A collapsing wall facade was built specifically for shots of the building’s face crumbling in the aftermath of the explosion. Essentially a jigsaw puzzle within a frame, the wall facade was rigged with nylon line and pyro charges so that individual pieces could be released on cue.

Edwin Rivera, “because it was locked off. Cesar had to comp in the live-action element of the street surrounding the real building, as well as some additional fire elements that were shot separately to augment the in-camera fireball.”

The following shot – the background for which was photographed from the rooftop of the ManuLife Insurance building across the street – would reveal a giant dust cloud billowing out from the building as the floors of the structure collapsed. “As important as the building explosion itself,” noted Beck, “is this huge, roiling dust cloud that extends outward in the ManuLife shot. We got as much of it as we could in the main element, then shot a separate dust cloud element to give us some flexibility.” The dust cloud was created by positioning air mortars – filled with a combination of fuller’s earth, vermiculite, walnut shells, talcum and ceramic tints – at the base of the building model. Once engaged, the mortars launched the mixture a distance of thirty feet. To make the cloud extend outward as far as possible, a primary row of air mortars at the base of the building was augmented with a second row, set further out. “Bob Spurlock was on the controls for the second row of air mortars, and he would hit that button as the initial dust cloud rolled past the first row, to make it continue to expand outward.”

To ensure that the billowing dust cloud would interact appropriately with prominent trees and other structures visible in the live-action plate, blue bucks were positioned around the model. “There was a foreground building in the live-action,” observed Gratzner, “that we duplicated as a blue buck. We also made blue trees out of chicken wire and plywood to represent the real trees. When the dust and all the dirt and debris came through, it would envelope these blue shapes; so the compositors could drop it into this area and it looked as if it were interacting with the real building and trees in the foreground.”

Timed with the dust cloud was the release of pneumatic cylinders that caused individual floors to collapse. “We also had, at the top, a beam that held up the roof,” recalled Hunter. “The roof on the real building was covered with urethane coating for insulation, so it looked like a huge sheet of rubber. On the model roof, we put a thin neoprene sheet up there, and underneath it we made some steel frames that were supporting this rubber roof. When it was set up, it looked flat and intact; but when the post holding up the steel frames fell out from the floor below, the unsupported rubber roof would sag and curl down. Mat really wanted that image in there.” The entire setup was rigged for maximum flexibility in shooting. “Each mortar and floor was hooked up to a solenoid release, which in turn was connected to Ian O’Connor’s sequencer box. That way, Ian could preset everything just the way we wanted. It also allowed Mat to change the timings, after reviewing dailies. We weren’t locked into a sequence that went from one to zero.”



Shots of the immediate aftermath revealed floors collapsing, dropping debris and creating a billowing dust cloud. Pneumatic cylinders were attached to specific floors so that they could be collapsed, then quickly reset for additional takes. To ensure that the dust cloud would interact appropriately with foreground trees in the live-action plate, tree shapes were fashioned out of wood and chicken wire and were covered in bluescreen material.



Model photography consultant Robert Spurlock confers with Mat Beck and Ian O'Connor at the miniature blast site.

The setup was also conceived to be easily and quickly reset and, after some practice, turnaround times got down to a mere half an hour. “It was designed almost like an amusement park attraction,” said Gratzner, “so that it could be continually reset throughout the day. We knew Mat wanted to be able to get shot after shot after shot, without long waits in between.”



A wide composite of the explosion featured the building model, live-action street elements and a digital matte painting of Dallas – assembled from still photos of the city – that included landmarks such as Dealey Plaza and the Texas School Book Depository.

During compositing, digital distortion was introduced to the ManuLife shot to make it look as if the live-action trees were swaying with the force of the impact. Separate smoke elements were layered into the areas surrounding the building. Finally, a matte painting, executed by Alison Yerxa and David Palmer and comprised of still photographs of Dallas, was added. Dramatic license was taken so that landmarks such as Dealey Plaza and the infamous Texas School Book Depository could be relocated and placed in the background. “They wanted to change the layout of the city a bit,” noted Yerxa, “and put in all of these buildings that make Dallas look like Dallas. Someone shot plates of the city for us, and we assembled those, tying them together with matte painted elements.”

The third shot in the sequence is a pan onto the still smoldering building behind Mulder, with remnants of debris falling into frame. Using motion control equipment supplied by Joe Lewis at General Lift, Duchovny had been filmed at the Unocal building, surrounded by a green card. “By design,” said Beck, “the dolly move on David ended before the building came into frame. Pan and tilt were the only axes, and they were encoded in case we needed the data.”

“We brought that into the computer,” added Derek Spears, “tracked the camera move and put that data into our motion control camera so that we could repeat the move on the miniature. Since the model was shot high-speed – at 96 frames per second – the motion control camera had to move really fast to duplicate the live-action move.”

“We did a lot of high-speed motion control on the show,” remarked John Wash. “In the panning shot, we see the federal building and all of this destruction, raining down debris and fires. A few years ago, we would have shot all of those elements separately and then laboriously tracked them into the pan. Now, we are able to drive the motion control rig fast enough to shoot at a high frame rate and get the reality and the wonderful interactivity that happens when those physical elements are part of the original miniature photography.”

Although assigned only three building explosion shots, the visual effects team filmed an additional insert – a closeup of the building from Mulder and Scully’s POV – that made it into the final cut of the movie. “It is a totally in-camera view of the building – and it looks absolutely real,” Beck observed. “The camera moves in and lingers on the aftermath. You see dust falling and little fires burning and sparks going off. You’d never know it was a model.”

Despite the heroic efforts of Mulder and Scully to evacuate the building, four people – a young boy and three firemen – are reportedly killed in the explosion. After being called before the FBI’s office of professional review – which appears to be leaning toward blaming Mulder and Scully for the deaths

– a morose Mulder stops at a Washington D.C. bar for a drink. There, he encounters Alvin Kurtzweil (Martin Landau), an author and discredited doctor who claims to have information about a government project involving alien colonization through a terrible and prolific virus.

At Kurtzweil's urging, Mulder convinces Scully to perform an unauthorized autopsy on the explosion victims' remains to determine if they died as a result of the blast or if, as Kurtzweil insists, the blast was intended to cover up evidence of the alien virus. A.I. provided the charred remains of one fireman, taking a lifecast of the actor, creating a sculpture, then running skins made of silicone. The completed effect, executed in approximately six weeks, was a translucent, gelatinous torso and partial limbs. When A.I. arrived on set with the corpse, however, Chris Carter suggested that the scene called for a more severe effect. Rather than a body that was translucent – meaning that there was still some color and milky skin to the skin – Carter wanted the fireman's body to be nearly transparent.

Production shot around the fireman during the autopsy sequence, intending to shoot inserts in about two weeks' time with a new version of the dummy. But A.I. – heavily involved in creating other effects for the show – was in no position to redo the fireman in such a short time-frame. A decision was made among all to turn over the assignment to KNB Effects Group. Provided with A.I.'s morgue fireman molds, KNB was able to get a jump-start on the project and concentrate all of its efforts for the following two weeks on the single effect.

Scully's autopsy confirms Kurtzweil's claim that the body had been infected with some kind of unknown virus prior to its being burned in the explosion. Now suspecting a conspiracy, Mulder and Scully go to the FBI field office in Dallas to sort through debris taken from the destroyed building. What they find is a bone fragment that appears to contain the same virus – a fragment, they learn, that was taken from a dig site in the Dallas suburbs. But when the agents arrive at the site, they find only a recently erected playground and expanse of green lawn. All evidence of the doomed Dr. Bronschweig and his field testing facility has been eliminated. After a quick interrogation of local kids reveals that tanker trucks carrying a mysterious substance from the cave have just left the area, Mulder and Scully race to catch up to them, finally arriving at a bluff from which they see a large cornfield and two giant, glowing domes.

With the bluff shot at a canyon in Santa Clarita and the cornfield shot the following week in Bakersfield, the visual effects team was responsible for marrying the two plates together into one startling image. Bluescreen material was suspended from a crane in front of the bluff by key grip Jim Sweet, and was supplemented with boards that were quickly painted blue when the screen was not big enough to accommodate a second, unplanned shot. The quick-and-dirty bluescreen made for a less-than-ideal matting area when the shot was composited at *Blue Sky | VIFX*. "Visually," remarked Matt Ferro, "these bluff shots had to be dramatic and powerful, because this is the first time you see physical evidence of human cooperation with the alien colonists. The problem was that these shots had some of the gnarliest mattes I've ever seen – primarily because there was a big thorny bush in the foreground that we had to see the domes illuminate through."

Mulder and Scully investigate one of the dome interiors, but are soon chased out by swarms of bees released through mechanical louvered floor units, fabricated by Hollywood Special Effects. To provide some atmosphere and physical interaction with the actors and their stunt doubles, thousands of real bees, wrangled by entomologist Norman Gary, were released on an enclosed dome set. Then, in postproduction, the practical bee swarms were augmented with CG bees in approximately thirty shots achieved by Blue Sky | VIFX. “The scene demanded that the bees be purposeful in their behavior,” noted John Wash. “They had to move in a very directed way from the louvers in the floor of the dome towards a vent at the top. Mat also had the idea of seeing the bees travel in sinewy rope shapes, which was much more interesting, visually, than an amorphous blob of insects flying around. CG bees were needed for that, because they could never have wrangled real bees to behave that way. About eighty to ninety percent of the bees in any given shot are our CG bees; the real bees are just atmosphere.”

A bee was modeled in Alias by the 3-D crew. “We even grew digital hair on the model to make it furry,” said Derek Spears. “Then we made several smaller, less-detailed versions for background. They were just a couple of pixels big and were the basic shape of a bee, like a jelly bean – no legs, no hair, nothing. In RenderMan we used a feature called ‘level of detail’ that allowed us to select, based upon how much screen space the bee occupied, what level of detail it would render. In the end, we created bees in several different resolutions, ranging from very detailed to very simple. There were also layers of what we called ‘dust’ – little spheres that were used to fill in the swarms in the background.” Houdini, a software package from Side Effects, was used for bee animation. “With Houdini as our particle system, we created this choreographed swarm of bees, adding a layer of randomness on top of that animation so that certain bees would shift left or dart right, independent of the movement of the swarm. In some shots, we had more specific moving bee ropes.” Bill Dietrich devised a method by which the bee ropes could be moved from point to point, flexing back and forth en route. “He built in a set of attractors along that rope – almost like magnets drawing the bees and pulling them along. The bees would still mill around randomly, but they were drawn to this rope and would take its general shape.”



Armed with information that the building explosion was part of a government cover-up, Mulder and Scully set out on an investigation that leads them to mysterious bee domes within a corn field in the middle of the Texas flatlands. Bee dome interiors were filmed on stage with thousands of real bees.



To create more precisely choreographed bee activity, the Blue Sky | VIFX digital department produced a swarm that included a variety of CG bees, from highly detailed foreground versions to dust-speck background ones.

Later in the film – just as Mulder and Scully move in for their first screen kiss in the hallway outside Mulder’s apartment – Scully is stung by one of the virus-carrying bees, and immediately loses consciousness. She is then whisked away by syndicate workers posing as paramedics and put on a plane. Armed with a virus vaccine and coordinates, Mulder tracks his fallen partner to the Antarctic where he encounters a mysterious ice station. Trekking through the snow, he suddenly falls through the ice into what appears to be a ventilation system. Crawling through a duct, the agent emerges onto the interior balcony of an immense spaceship.

The utilitarian-looking ship is made up mostly of giant tubes and corridors which are lined with cryopods – cryogenic containment units housing human hosts for the alien virus. Both A.I and KNB provided the host bodies, the former creating two articulated versions that would be seen moving as the creatures begin to hatch, the latter creating nonarticulated background versions. A.I’s hosts – one of them the primitive man infected in the film’s opening – consisted of vacuformed cores covered in near-transparent silicone. Articulation was provided by cable controls, operated from off-camera. Within the two mechanized bodies were articulated aliens – modified versions of the suit worn by Tom Woodruff for his creature performance. By taking in darts and tucks in the body suit, the makeup team could fit the full-size head and body into the distended abdomen of its host, making it look as if it were in a fetal position. The alien head was operated via remote control for blinks and other facial movement; but articulation of the body was achieved more simply by hand-manipulating the creature from an opening behind the host puppet.

The KNB nonarticulated hosts reflected two stages of alien infection. Five male and five female first-stage dummies were constructed to appear as relatively normal frozen bodies, while two males and two females were sculpted with withered limbs and bloated abdomens signifying second-stage infection. Both versions were made of silicone, with a vacuform core to represent bone and muscle tissue. The alien embryos visible within the second-stage victims were merely painted onto the cores, since no articulation was required. Among those victims entombed within the cryopods is Scully. KNB built several nude Scully dummies for shots of the character within the iced bubble, using a head cast of Gillian Anderson and a body cast taken from a double.

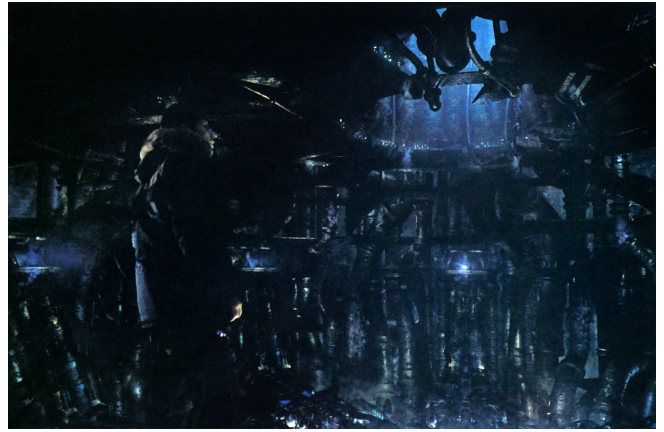
Breath shots to sell the coldness of the spaceship interior were added relatively late in postproduction. Thirty such shots were assigned to Hollywood Digital, which took elements produced by Blue Sky|VFX for *Titanic* and tweaked them to work for *The X-Files*. “The one thing missing in the sequence,” commented Kurt Williams, “was this sense of cold; and the best way to bring that to life was to add breath vapor. So we went to Hollywood Digital, with whom both Mat and I have had experience. The people there, especially Peter Koczera, are terrific.” Beck, Williams and the Hollywood Digital team referenced several films for the breath shots – including *Fargo* and *Titanic* – and found that there was a tremendous variety in the way breath looked in the cold. Each of the shots would need to be tweaked and finaled on an individual basis. “Most of the work was in getting the densities and colors just right. The lighting in the spaceship interior was very tricky because there were light sources from the floor, the pods, all over the place, and they were all different colors. So Hollywood Digital had a lot of work to do, just integrating the breath elements into the scene in terms of color and lighting. The other key issue was that they had to track the element to the actor, fading it out at just the right moment so it wouldn’t linger too long.”

Uncertain as to where he is, Mulder begins exploring the cavernous space in search of Scully. An enormous set was built on Stage 16 at Fox to represent the spaceship interior; but while the soundstage was filled to capacity, that set represented only a fraction of what was supposed to be a 1200-foot-diameter craft. Ninety percent of the interior would be created through digital set extensions, generated by Light Matters and matted into green or bluescreen areas surrounding the stage. Colors and lighting on the set presented Beck with the worst-possible matting situation. Practical cryopods lining the set corridors glowed green; the tubular structures were blue-green; greenish lighting permeated the live-action; and Mulder's wardrobe in the scene was a deep blue. Hence, matte color had to be determined on a shot by shot basis – sometimes, from one specific area of a shot to another. A third matte color was introduced with red cubes situated around the set to guide the match-move effort in postproduction.

Prior to filming, only nine digital set extensions had been budgeted. “Initially, most of the sequence was going to rely on the practical set,” stated Williams. “But as they began to shoot on it, we all realized that we needed a lot more depth in the spaceship. The only way to do that was through the CG model of the spaceship interior, which we were going to be producing anyway. It gave us the option of revealing a vast space, as opposed to shooting the entire sequence really tight. Mat and I had to figure out how to do that for the least amount of money, using the same 3-D model and producing the most number of shots possible.” Ultimately, the count grew to forty-eight digital extensions. “Originally, we were getting Mulder from point A in the spaceship to point B – but that was about it. As they got into the sequence, they came up with new, more dynamic moments, and everything built to a much bigger, more exciting sequence. Five or six of those shots were pivotal because they really showed the entire scope of the interior, establishing that there are several thousand cryopods within this ship.”

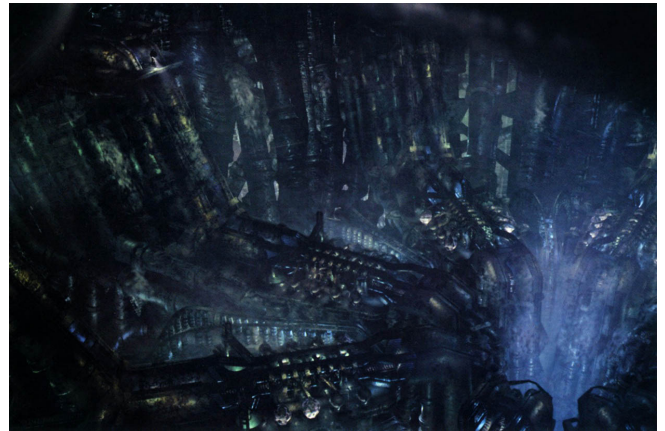
The digital set extensions, depending on angles and camera movement, required either full 3-D geometry, 2-D matte paintings, or a manipulation of the 2-D imagery, dubbed ‘two-and-a-half-D.’ Most of the shots relied on a combination of all three approaches. After doing a quick 3-D tracking on the live-action camera move, the digital team would render out a low-rez version of the set extension to determine how much perspective shift was apparent in the shot. “If there wasn’t much shift,” explained Colin Strause, “we would just break it into layers, all sliding against each other, to make it look like a little shift was happening. In other shots, the foreground would have to be full 3-D, but the background could be made up of layers of 2-D elements; and the layering would be enough to give it a sense of depth. It actually gave us much more flexibility than if we had done all of it in 3-D. Mat could say, ‘Change a highlight here,’ and since it was a 2-D image, we could just paint one frame and then rerender the composite. If it had been 3-D, we would have had to actually engineer where the lights went in and where they fell off, and then rerender all of that.” The 3-D modeling was done in Alias, while all tracking, painting and compositing was done in Amazon Paint and *Piranha*.

One of the most challenging set extension shots was the initial reveal of the spaceship interior as Mulder emerges from the ventilation duct onto a balcony. More than six hundred frames long, and containing nearly one hundred layers of computer generated elements, Beck appropriately dubbed it the whoop-de-do' shot. "The camera moves around Mulder to reveal this interior," Strause noted. "It is a full pan, a little more than 180 degrees – so just the tracking was a big ordeal."



When Scully is stung by one of the bees – carriers of the alien virus – her comatose body is whisked away to a spaceship nestled beneath the ice of Antarctica. In search of his fallen partner, Mulder finds his way into the alien craft. Live-action was captured on a set that, while massive, represented only a fraction of the ship interior. The majority of the space was created through digital set extensions produced by Light Matters.

As Mulder attempts to reach the cryopods below, he slips and slides down a long, narrow tube, grabbing a ledge when he reaches the end and hanging over a deep chasm. Originally, his descent to the lower corridor had been an uneventful climb. But in the months between the end of production in October and the two-week reshoot in late February, the filmmakers had conceived the more perilous descent. To accommodate the new action, David Duchovny was filmed on a sled device that propelled him down a practical tube, and was also shot hanging over a greenscreen for insertion of the computer generated chasm. "The camera was on a crane," remarked Beck, "so it was bouncing around a lot – we were scrambling to put in tracking marks that stayed in the frame. Rob is a terrific visual director who knows how to move a camera to get maximum energy and drama and still have it be trackable. It adds to the complexity of the shots, but it's worth it because it's organic. I've done so many shots looking down, and it's always a fight to make them look scary. The moving parallax shift is what adds vertigo and depth. Erik Liles and Jodi Campanero went only slightly nuts tracking the 3-D move. Don Bixby, our gaffer, helped by giving us an even greenscreen under difficult conditions."



To realize the vast interior, Light Matters digital artists created layers of 2-D art that could be shifted and tweaked to suggest camera-move perspective shifts.

Shots of Mulder sliding down the tube also featured a combination of stage footage and digital imagery. Duchovny was rotoscoped out of the practical tube – which had been built quickly and without much attention to aesthetic detail – and placed within a CG tube environment. A couple of shots in the sliding sequence were one hundred percent digital. "In those shots," explained Strause, "you just see Mulder's POV of this long tube that seems to go on forever – and that's all CG. They'd filmed a practical POV shot by putting a shaking camera on the sled device and sending it down the tube. We tracked that to get the camera movement so our CG replacement would have the action that the director wanted. Once he is at the end of the tube, Mulder grabs onto the ledge, swings out,

and the camera pulls up to reveal that he is hanging over a 2000-foot-deep pit. You see his binoculars fall into this chasm, and we created 3-D binoculars for that. Then there's a huge, complex 300-frame shot of him getting his grip and crawling back up, with this 3-D chasm below him the whole time."

Finally reaching Scully, Mulder shatters a thick covering of ice over her cryopod with an oxygen canister. The ice-breaking effect – along with following shots of the fully gestated aliens awakening and breaking through other pods – proved to be one of the most difficult of the show. The cryopods themselves were mechanical units modified by Paul Lombardi's crew when the originals, built by an outside vendor, had failed to perform as designed. The modified versions had paddles that opened pneumatically, allowing the release of slushy ice and water. Even more problematic than the cryopod mechanics, however, was simulating breaking ice. Initially made of resins, the ice covering either broke too easily or not easily enough. In the end, the ice-breaking scenes were put together in quick cuts, with different materials being used for each. Breakaway materials were incorporated into specific areas of the cryopod shield for shots of a creature's hand bursting through, for example, while a more heavy-duty material was employed for shots of Mulder hitting the ice as he attempts to get to Scully. In a last-minute idea by Dan Sackheim, closeups of Scully and other victims in suspended animation within the pods were achieved by submersing and filming the actors in a warmed tank of water.

After Mulder injects Scully with the vaccine, the spacecraft rumbles to life, cryopods start to melt, and aliens begin hatching from their hosts. With one of the creatures close behind, Mulder half-carries, half-draggs Scully to the top of the ship, through the ventilation duct and out through the hole in the ice. Within moments, the ice field begins cracking, due to heat generated by the awakened ship. Massive blocks of ice collapse under their feet as the two agents attempt to outrun the ever-widening circle of imploding ice and snow.

The entire forty-shot sequence – from the first cracking ice shot to the rising of the spaceship and, finally, its disappearance in the sky – was realized by *Blue Sky*|VIFX. "We needed *Blue Sky*|VIFX's ingenuity for those pivotal shots," noted Kurt Williams, "because they were going to be made up of multiple elements, with a constantly moving camera. It required every trick in the book – 3-D, 2-D, compositing, live-action, models. All of those techniques were combined into a sweeping, two-minute-long sequence that was almost entirely effects."

Animatics would help determine how each series of shots was achieved. Live-action footage of Mulder and Scully running on the ice was shot on a refrigerated stage, where a 25-by-90-foot blanket of snow and ice was laid out on an eight-foot-tall platform. Underneath was a Lombardi-engineered trough and pump system to clear the area of slushy water from ice melting under hot stage lights, as well as generators that were used to create geysers of steam launching into the air.

That live-action was then married to dynamic imploding ice shots, captured with a variety of miniature setups, augmented digitally. Initial images of the ice cracking beneath the characters' feet were among the shots that relied on digital enhancement. "For some of the wider shots," noted Derek Spears, "we added cracks along the ice digitally. We made a piece of art, a diagram of the cracks, then digitized that artwork into a set of lines in the computer. Then we took those lines and pulled them apart to open up the cracks. As they opened, we added a little bit of particle snow that

fell in. We also added some displacement on the surface around the cracks, so as they opened up there was a reaction on the surface, rather than just being a static image. That made it more interactive.”

One of the miniature ice setups – commissioned late in the show, when the filmmakers realized they needed to more deftly foreshadow the imploding ice event – was dubbed the ‘cracking ice hole’ and was used to show fissures opening up in the ice surrounding the hole from which Mulder and Scully have emerged. “We shot the characters greenscreen,” recalled John Wash, “then composited them into this cracking ice miniature. Because we got these shots so late, that whole setup had to be designed, engineered and mounted very quickly.”

The half-scale miniature was orchestrated as a joint effort by Wash, the model crew and Bob Spurlock. “The cracking ice hole set is really the fuse that sets off the sequence,” noted model shop supervisor Scott Schneider. “Mulder and Scully climb out of the hole that Mulder originally fell into, and suddenly the ice around them begins to crack – and the hole they just climbed out of grows to twice its original size. Mat did not want just a surface with cracks running through it. He wanted the surface to shift and settle, as if blocks of ice were losing their footing. To do that, we built a wedge-shaped set – twenty feet wide in the front, thirty-five feet in the back and thirty-five feet deep – covered with styrofoam blocks cut into various shapes. The foam blocks sat on top of platforms supported by two-by-fours; and when those platforms dropped, the blocks would settle and shift sequentially. From the top, it looked as if the field of ice was cracking outward from the center.” Three different shots were accomplished on the cracking ice hole miniature: a shot from above, looking into the hole, with Scully’s feet hanging over it; a shot that starts on Mulder, then booms up as the characters flee; and a shot from down low that tracks right as the characters move away from camera.

For the shot with Scully’s feet in frame, the original plan was to puppeteer half-scale limbs; but the effects team ended up shooting the feet full-size. “It just looked better,” noted Beck, “and we wanted to change the scale of the legs in relation to the event, anyway. So it was actually Scott Schneider putting in a moving performance as Scully’s legs – and nearly getting parboiled by surrounding steam for his trouble.”

As the ice field continues its rumbling and shaking, the ice station – a set of domed structures from which the syndicate monitors activity within the spaceship below – falls into a hole and disappears. For live-action exteriors preceding the action, a full-size ice station set had been built and shot on the Pem-berton Ice Cap. Much later in production, interiors that showed characters’ reactions to the subterranean tremors were filmed on a stage set, rigged by Paul Lombardi to shake, rattle and roll. Those were followed by miniature shots of the ice station antenna hitting one of the domes and a ground view of the entire widening circle of imploding ice. Wide and high-angle views of the ice station disappearing into the chasm were achieved in either CG or miniature, depending upon the cut. “We built a twelfth-scale model of the ice station,” explained Schneider, “working from aerial photographs of the full-size setup on location.” Patterns for the model were made out of vacuform plastic. “We cast the pieces out of rigid urethane, backed by urethane foam, then added detailing such as barrels and tractor treads in the snow. The biggest dome ended up being about ten inches tall, and smaller ones were seven or eight inches tall.” To release the model into the chasm as blocks

of ice slide away, the crew set up plywood platforms, stacked with styro-foam blocks, that would slide to the left and to the right, creating an opening in the middle.

Subsequent wide views of the characters running across the imploding ice were captured on another tabletop miniature – a huge setup that represented the expanse of the glacier. “The idea,” explained Schneider, “is that the glacier is imploding in a radial pattern, because it’s collapsing out to the edge of the massive ship. So we had to create the effect of this ice falling into a chasm – but it couldn’t be just a straight edge of ice falling. It had to grow radially, like the effect you get when you throw a stone into a pond. When Mat first described the concept to us, we were all scratching our heads, thinking, How in the hell are we going to do this?” Schneider and Wash joined mechanical designer Erik Haraldsted, special effects supervisor Ed Felix and Spurlock in devising a suitable approach. “It had to be something that could be reset relatively quickly; it had to have flexibility so that we could tweak things from take to take; and it had to have steam interacting with it. Eventually, Erik came up with an elegant and amazingly simple idea – similar in concept to the old ‘pull-out-the-tablecloth-and-leave-the-dishes’ trick.” The approach was first tested in smaller scale, using motion control rigs and a piece of plywood to simulate a tabletop. “We cut some styrofoam blocks and placed them on this twelve-by-four-foot piece of plywood, then pulled out the plywood -just to see if the approach would work at all. One of the things we had to figure out during the testing phase was the scale of the ice blocks. If they were too small, we would have needed more of them – which would have meant a longer reset time. But if they were too big, they might not look right or fall correctly. It was a big issue.”

“We dealt with this elusive concept of scale for the ice for a long time,” Wash concurred. “If you are building a miniature structure of some kind, you’ve got doorways and other architectural features to guide you. But the scale of a block of ice is more abstract – a ten-foot-tall block of ice looks the same



Among Mulder's discoveries within the ship are rows of cryopods used to maintain alien-infected human hosts. Mechanical versions of the host bodies were built by A.I. Project coordinator Andy Schoneberg sculpts the head of a primitive host infected by the virus in the movie's opening sequence.



as a block of ice that's fifty feet tall." The scale of the miniature was eventually determined on a shot-by-shot basis; and, ultimately, scale was suggested more through the speed at which the collapsing event happened than through the size of the individual styrofoam blocks.

Also determined during the testing phase was the size of the tabletop miniature. "We went through each shot," commented Bob Spurlock, "and with a still lens we looked at the mockup from that particular angle. By looking through that view on the mockup, we could see if the tabletop miniature was going to be big enough; and if not, we could adjust it. Then John Wash took that information and fed it into one of his computer programs that spit out how big it needed to be. We could see from these various camera angles that it was going to have to be bigger than we'd originally thought."

Common table salt proved to be a good stand-in for snow. Among the problems that needed to be solved, however, was its tendency to fall through minute cracks between the styrofoam blocks whenever the table was inadvertently bumped. To solve the problem, white wrapping tissue was torn into strips, laid over each crack and wetted down before the salt was applied. "The tissue paper was just strong enough to keep the salt from falling through the cracks," noted Schneider, "but it was weak enough to tear instantly when the blocks fell. Since it was white, it blended beautifully with the blocks and the salt."

With the success of the mockup, the crew turned to building the actual tabletop rig on stage at the Blue Sky|VFX annex. The setup consisted of three triangular tables, on top of which were stacked two thousand carved styrofoam blocks, coated with stearic acid to make them resemble ice. Table salt was laid over the styrofoam blocks and wetted down with hair gel to make it clump together like powdered snow. The completed structure was six and a half feet tall; and with the tables in their starting position, the miniature was twenty-one feet wide in the front and fifty-six feet wide at the very back. "In total," commented Schneider, "there was a twenty-foot area of table that moved, and fifteen feet of background dressed with salt. Everything

Bob Spurlock, Blue Sky|VFX, built the first principal and principal understudy by the effect of the speed of the collapse. This is a comparison of the original and the final on a female host.



After freeing Scully from a cryopod, Mulder hastens to escape with her via the ventilation duct through which he had gained entrance to the ship. Actors David Duchovny and Gillian Armstrong were filmed on a small set, which was then extended digitally by Light Matters.



During the film's climactic sequence, Mulder and Scully attempt to outrun an avalanche of collapsing snow and ice caused by the powering up and rising of the huge spaceship. To achieve the cataclysmic event, live-action footage of the actors running on an ice-covered platform was composited with a tabletop miniature built and photographed by Blue Sky | VFX.

was framed in steel and decked in wood.” Table movement was effected by three ten-foot pneumatic air cylinders run through an elaborate cabling system – designed and fabricated by Haraldsted – that ensured the three tables would stay in sync. “The whole setup was launched by releasing pelican trips that were holding everything together. So the pneumatics gave us the locomotion, but the trip releases were what held the tables together and prevented them from moving until we wanted them to. When we were ready to go, we’d fire the trips through the computer, which was also linked to the camera. When we rolled camera, that would set off the trip releases, and all three tables would fly back twenty feet, making all the blocks fall off as the table edge went out from under them. It made a loud, roaring sound – and in four or five seconds, it was all over.”

Initially, the tabletop was also rigged with steam lines, positioned at the leading edge to launch jets of steam into the air as the ice gave way. But when the practical jets failed to scale convincingly, the visual effects team decided to shoot separate steam elements and composite them in post. “It was more important simply to have a general mist mixing with the ice on the front edge of the tabletop, rather than actual plumes of steam,” Schneider explained, “so we changed the rig in front to create a mist. We also had a little bit of steam at the bottom, so it would look as if the ice blocks disappeared into a nebulous hole.” That illusion was particularly important for a high-angle shot looking down at the tabletop. “The blocks were landing on the floor, which you could see clearly in this shot. The digital compositing people were worried about having to paint out all of those blocks lying there. But Erik Haraldsted and Ed Felix came up with the ingenious idea of rolling bluescreens onto a pipe that was attached to the tables; so that when the tables pulled back, the bluescreen would unravel. The blocks would fall through the veil of steam that was at the front and land on the floor; and as soon as they landed, the bluescreen would roll over them. By the end of the shot, there was nothing but bluescreen covering the floor. It was a simple, mechanical solution – and it made the roto guys very happy.”

Once the event was over, the crew would set up for the next take. Resetting was a tedious affair. “It took two hours just to get the blocks picked up and cleaned and set aside,” Schneider recalled. “It took another six hours to set them up, since they had to go in a particular order, without any big gaps. Then it took another four hours to lay all the salt on.”

While the mechanics of the tabletop worked perfectly, the miniature was a difficult one to shoot and light. A great deal of illumination was required to match both the live-action shot on stage and that shot on the real glacier, since the sequence took place in bright daylight. “Our biggest problem,” observed Wash, “was maintaining depth of field. In the real world, in full size, on a bright day and on a bright glacier, you’d be shooting in the upper ranges of f-stops, and so there would be enormous depth of field. To duplicate that at high-speed we used a lot of light and shot with tilting lenses that allowed us to tilt the plane of focus. We could rotate the lens up or down, pinpointing the focus area.”

Another hurdle was that, in order to duplicate camera moves made on the characters on stage, the high-speed shoot on the miniature had to be accomplished via motion control. “There was one pretty elaborate boom shot of Mulder and Scully,” Wash recalled. “It started very high, with them in the distance, then came down as they ran just under camera. Derek Spears’ department tracked the scene in the computer and generated motion data, which was imported to our motion control rig so

that we could repeat the move on the tabletop miniature. It had to be smoothed somewhat so the motion control rig could copy what the physical camera did on stage. We were shooting at 96 frames per second, so we were pushing the motion control rig to the limits of its capabilities.” The smoothed-out bounce of the camera was put back in digitally when the shot was finally assembled.

Views that could not be accomplished on the tabletop setups were assigned to the Blue Sky|VFX digital department. “We couldn’t cover the entire sequence with the miniature,” said Beck, “because it would have required a model that was ten times as big. We just decided on a certain size and said this will work completely in-camera for some shots; and for other shots we’ll have to extend it or augment it through cloning. So the sequence is made up of a combination of live-action on the set, a tabletop miniature and digital techniques.”

To duplicate the look of the miniature in CG, digital artists went through an elaborate research and development project. “We used rendered ice chunks and particle systems to generate the smaller debris,” said Walsh. “I was skeptical in the beginning; but by the end, our CG ice team – including Mike Lafave, Andy Gauvreau and Bob Mercier – made me a convert. It was gratifying to see that we could duplicate the miniature effect – which was organic and photoreal and full of tiny details – in a CG environment.” Backgrounds for the miniature shots were provided by digital matte paintings made up of stills from the location glacier.

Unable to outrun the leading edge of the collapsing ice field, Scully and Mulder disappear into the chasm. They reappear moments later, however, clinging onto the spaceship as it rises majestically from the vast hole. The alien spaceship would figure prominently in the film’s climax, and was realized through models built and shot by Blue Sky | VFX. “It was really cool to be working on another spaceship for a Chris Carter story,” said Beck. “Chris is a visionary who still gives us creative room to work.” Elegant drawings of a basic saucer-shaped craft, rendered by concept illustrator Tim Flattery, were taken to the next stage by Mat Beck. The design was then translated into an Alias 3-D model, enabling Beck to continue tweaking and refining the design. “I wanted the ship rendered in CG for several reasons. One, Alias is a good, precise CAD/CAM program, if it needs to be. It also gave us a 3-D model that we could light and look at from different angles. Finally, we could use that CG model as a distant ship, if necessary.”

Synthesizing input from Chris Carter, Rob Bowman and Dan Sackheim, Beck worked with John Wash and Scott Schneider to design a ship that was simple in basic form, but extraordinarily complex in its texturing and detailing. “The devil was in the details,” Beck stated. “Chris originally wanted the ship to look very smooth; but I pointed out that if it was too smooth, it would look like a miniature. It needed to have enough detail on it to create a sense of scale. We went through a lot of tweaking to come up with something that was simple, but had some underlying complexity.”

Once the essential design had been established in 3-D – a design that featured asymmetrical disks, diving-board-shaped extensions and extensive piping that converged at a center recess in the saucer – the issue of scale was addressed. “The first thing we had to decide,” said Schneider, “was how big to build the motion control model. We created four-foot, six-foot and eight-foot mockups, and looked at all three of them through the camera lens to determine which size would hold up best on film and would be the easiest to work with. Finally, we decided that the six-foot-diameter, 200th-scale model was a good size – not too big and not too small.” Even at this stage, the finer

details of the ship's design had not yet been pinpointed. "We had a shape and some basic features, but we still had to figure out what we were going to do with the textures on the surface. That's when the ship design went to Alison Yerxa, who started coming up with textures."

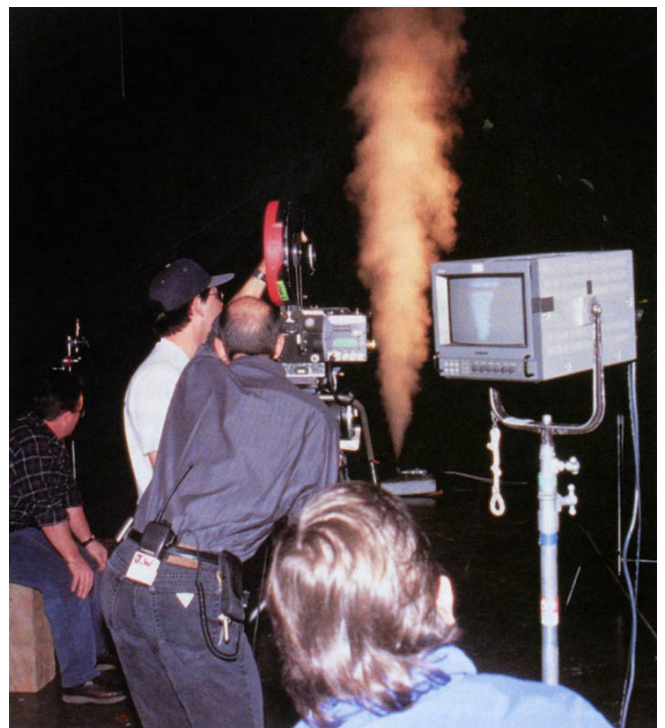
"I was looking for detailing that would be sensed, but not entirely perceived," Beck commented. "The suggestion of detail beyond what could be seen would not only make the ship look very big, it would also serve as a metaphor for the show – there is detail beyond detail beyond detail, just beyond your perception. I wanted something that would look like cellular structure that repeated itself, but wasn't completely regular." Initially thinking in terms of textile patterns, Beck asked Yerxa to scan fabrics into the computer to see what kinds of results might be produced. He also suggested that some appropriately structured, yet random textures might be obtained from aerial photography. "I was thinking of Paris, but Alison found some aerial photography of Moroccan villages and river deltas that was really interesting. Once that photography was scanned in, we could see that it was the way to go."

The results were promising, but there was initial concern as to how such dense texturing could be achieved practically. "As exciting as these textures and surfaces looked," Schneider remarked, "I was getting a little nervous as to how we were going to do this. Throughout the design process, we'd been discussing the possibility of including a lot of filigree work on the model, using acid-etched brass. I started wondering if we could apply the same technique to the surface detail. We talked to the people at Insight Designs – an acid-etching company that typically produces circuit boards for the computer industry – and started sending them Alison's artwork to see what they could do with it."

A halftone process elicited not the lattice-type etched brass commonly used in model work, but rather a raised pattern, like a metal plate embossed with Braille. "Etched brass is an old tool in modeling," remarked Beck, "but we used it in a new way. Instead of etching all the way through the



The tabletop miniature was made up of two thousand carved styrofoam blocks, set up on three pneumatically controlled tables that could be pulled apart quickly, causing the blocks to fall away. Lead modelmaker Logan Payne carves a styrofoam block into the desired shape.



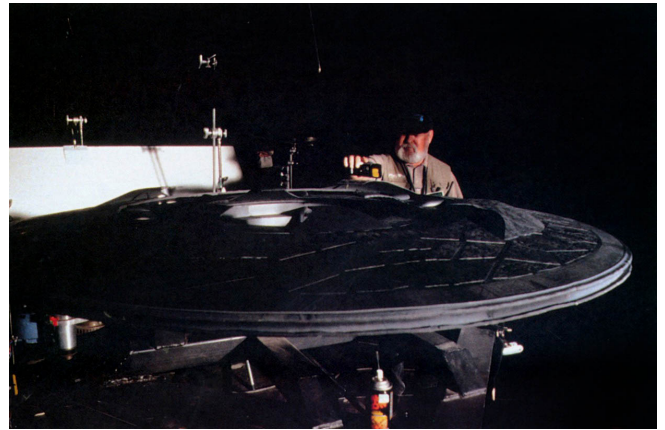
brass, we had the etching done as if we were making a print plate out of it.”

“Once we established the patterns,” Yerxa added, “they were sent to photolithographers, and we got back a screened print. The screened print was then given to Insight Designs and they made the etched brass pattern pieces, using a gray-scale piece of artwork. The gray scale would give us varying depths in the etching, depending on the brightness or darkness of the gray. What was experimental about it was that we used a very limited gray scale – between ten and thirty percent. If we went darker than that, it etched everything out; but at that range, it created all these tiny little lines, almost like a diffraction pattern.”

An unexpected benefit of the etched-brass detailing was discovered after it was applied to a test model piece. “We pulled urethane castings off the brass,” explained Schneider, “painted them and applied them to a surface that was representative of the curvature and angle of the ship. When we hit it with light, it created a moiré effect. Mat was very excited, because he was always trying to maintain the X-Files credo, which is to hide things in plain sight. All the areas that were exposed to light would have this bizarre moiré pattern – but when they fell into shadow, they would change immediately to the look of flat black paint. So the surface was always changing as the ship moved, depending on if it was in shadow or in light – and Mat really wanted that quality.”

To get a jump on the project, and to give Beck a tangible model to work with, Schneider’s crew began building the ship even though the finer points of its design had yet to be determined. “There was only so much Mat could do with a computer model,” Schneider observed. “Once he had the physical model, though, he could put his hands on it, light it, play with it and fine-tune it. Mat really likes to play with things. He’d get in there and grab something, and say, ‘Can I break this?’ And I’d say, ‘Go ahead.’ He’d break it off, reposition it, look at it, reposition it again. It drove the modelmakers crazy sometimes – ‘He’s breaking my model!’ – but I liked it. It told me that he had a profound interest in what he was doing. Mat was in there tweaking that model clear

By Mulder and Scully, the ship rises from the glacier and disappears into a swirl of turbulent clouds, a moment of awe and wonder. The ship model featured etched brass detailing derived from scanned aerial photography, as well as white neon lights colored blue-green in postproduction.



Shots of the spaceship rising from the glacier and disappearing into a swirl of turbulent clouds were also realized by Blue Sky | VFX with a six-foot-diameter saucer model. Visual effects director of photography Jim Weisiger checks the light levels on the spaceship.



As Mulder and Scully watch, the alien craft rises into the sky. The actors, ice set and spaceship were all shot separately, then integrated into a final composite. The ship model featured etched brass detailing derived from scanned aerial photography, as well as white neon lights colored blue-green in postproduction.

up to the last minute of the day it was on set for shooting.”

The model took a full seven months to complete. Lead modelmaker Logan Payne spearheaded the building of the spaceship, which, in its completed form, was made up of an epoxy casting over an aluminum chassis. White neon was installed by Nights of Neon to create edge lighting along the interior and exterior, colored digitally in postproduction to the greenish-blue that was prominent in the live-action ship. The center pipe area of the ship, built by Mike Possert, was rigged with oversize fiber optics to create general pools of light. Detailing included plastic piping – dressed with U-channel at the top to make it look more exotic – and a mottled paint job. “Everything on this ship was fabricated,” commented Schneider. “Not one thing came out of a model kit – although, we did stick a Han Solo figure from a *Star Wars* model kit inside, where the camera would never see it.”

A larger-scale model was also built specifically for medium shots of Mulder and Scully being carried on a section of the rising ship, then rolling off. “That model was made out of a steel frame, with a top and bottom made of lumber and plastic,” explained Schneider. “It represented a 150-foot-wide section of the ship, and it was fifteen feet wide, ten feet tall and ten feet deep. My big worry with this model was how to duplicate the acid-etched brass detailing in larger scale. For the 200th-scale model, I’d had the etching company make the pieces, and then we took molds off of them. But we could not do that for this model because they can’t acid-etch pieces that big. The largest piece they could do was eighteen by twenty-four inches – and I couldn’t imagine trying to detail this large model with all these little pieces. So we blew up the surface detail to this larger scale, showed it to Mat and said, This is what it really looks like eight times larger – but is this what we want it to look like?’ Mat made some changes; and then, instead of using the dot pattern of the etching, we added texturing by stippling bondo on the model. We also laid out crumpled-up foil, which was stretched back out but still had a rough, crinkly texture. We spray-glued sand onto that and painted it all flat black, stippling on opaquing fluid to match the paint texture.”

The first approach to shots of Scully and Mulder sliding off the ship section had Anderson and Duchovny rolling around on a rising greenscreen platform. The intention was to composite that footage with the scaled section model. Eventually, the composite solution was replaced with a practical approach – and the eighth-scale spaceship section never made it into the film. “John Wash and I agreed that it was preferable to have the actors slide on a real set piece,” explained Beck. “So production built a fifteen-foot set piece and redid it in-camera, during the reshoot. Paul Lombardi had liquid nitrogen and water flowing on it, which hid most of the set piece, anyway. Then, to make it wide enough to go to the edge of frame, we digitally cloned that real set.” For a subsequent side view of the characters tumbling from the ship, Rob Bowman determined that he wanted a wider shot than that afforded by the fifteen-foot practical prop. To facilitate that wide view, Mulder and Scully were matted onto a plate of the six-foot ship model.

From the ground, the two agents witness the ascent and disappearance of the ship within a vortex of clouds. The manner in which the spacecraft would vanish was a subject of uncertainty for some time. In the original script, Carter had described a ship that glowed white hot and finally disappeared in the light. That idea evolved into one in which the ship would be obscured by swirling clouds. “Chris wanted something fantastic,” noted Wash, “but it also had to be grounded in reality. If the ship disappeared in some kind of supernatural way, audiences would not accept it. We had to

tread that fine line between what was magical and what was believable; and finally we settled on the notion of a turbulent weather system that would partially obscure the spaceship in the sky.”

“There was a precedent for this kind of obscured reveal in the TV show,” Mat Beck elaborated. “The ship in Paper Clip, for example, was revealed in shadow, and you couldn’t quite see it because it was too dark. And then we’d reveal it in light, and you couldn’t quite see it because it was too bright. We wanted to do the same thing for the ship in the movie. The idea was to define the spaceship not so much through the form itself, but through its impact on the environment – the ice field and the swirling clouds.”

The weather system was created by assembling a variety of elements, shot independently of the ship model. “One of the things I wanted in this sequence was a sense of a distant rainstorm,” said Beck. “When we were shooting some of our geyser elements for the tabletop miniature, after the geysers shut off there was this beautiful mist falling. John Wash and I decided to use some of that for the spaceship sequences. He got his guys to make up a rig of nozzles that emitted this really fine mist in the shape of the spaceship. The stuff we got from that was just beautiful. Then John set up a rig to shoot dry cloud tank elements.” Those elements were captured by filming cold smoke within a contained space at extremely high-speed. “It was like a big sandbox, with air movers blowing liquid nitrogen and smoke. Since it was going to have to interact with the ship, John shot elements of liquid nitrogen spilling over the sides of a mockup, which looked great. And we used that mockup to make the right-shaped hole in the smoke, to create the suggestion of the ship inside. We had the camera running as fast as 300 frames per second to get this slow-motion wave moving along. It was a major contribution – and typical of the caliber of John’s work.”

The spaceship’s appearance and disappearance represented the last major visual effects sequence in the film. A final composite, completed by Blue Sky | VIFX, reveals a cornfield in the middle of the Tunisian desert – proof that the syndicate is continuing its pollination experiments. The effects work was completed in May, about a month prior to the picture’s release. One unsung hero of the year-long project was visual effects coordinator Scott Shields, who worked side-by-side with Beck and Williams to manage the many-pronged assignment. “Scott was instrumental in coordinating this work,” Beck affirmed. “I could sit there and wave my arms and say, ‘Why don’t we do this or that?’ But Scott was the one who administered the whole thing, making sure comments were noted and entered and disseminated. Staying consistent with multiple vendors takes a lot of expertise and effort. Without Scott and Paul Molles in the office and Pamela Choules in visual effects editorial to keep things moving, we would have released this show sometime in the next century.”

What drove the visual effects effort, more than anything else, was the enthusiasm bordering on fanaticism that so many of the effects artisans felt for *The X-Files*. “At this level of filmmaking,” concluded Kurt Williams, one of the most devoted of those fans, “the work demands so much and takes such a big chunk out of your life, it can’t just be a job. It has to be a passion. For me, and for a lot of the people working on this show, *The X-Files* was a passion.”

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THE X-FILES™

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